Improving COLLEGE AND UNIVERSITY *Teaching*

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Improving College and University Teaching

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The Editor's Uneasy Chair

"In order to endure, an education must be self-achieved." "Each student's self-education should constitute the controlling object of any educational agency that deals with him." "But self-education without a notion to what end one is working is a contradiction." "The only aim that counts in self-education is the aim that actually exists in the student's mind." "Probably the best that can be done is to have the student prepare a descriptive topical picture of what after two, three, or four years, and from all sources, he hopes to have mastered—a picture that will develop its parts and relationships as he proceeds until it presents a consistent intellectual structure that becomes real to him because it actually houses him and invites extension."

"The aim that actually exists in the student's mind"

These statements were printed twenty years ago in the Carnegie report of the "Pennsylvania Study." Twenty years ago. But what do we know even now about the *aims* of our students? Even if we knew them, would we be utilizing them, guiding them, enlarging them? Are we not working in the dark about the aims of our students, ignoring them or at best assuming that they are thus and so without really knowing? What are their aims like? Are they at the level of merely piling up term credits or are they worthy ones? With all their getting should not students be committed to such goals as understanding, mastery, the marks of an educated man?

Is it not reasonable that a college or university, in guiding a student toward his degree, would require him at the start to state his purposes, then help him to revise them as he grows in knowledge and maturity, be a partner to him in their achievement? Are not the student's own purposes the most powerful dynamic force that could be utilized in his educational progress? We become concerned and grave about student failure —and failures include many of the able. What if we have contributed to failure by our disregard of simple psychological and moral maxims, such as: "Pep without purpose is piffle." "Not failure but low aim is crime."

If students spend four years on campus in purposeless activity, in credit getting, or in pursuit of nonintellectual goals, ought not we as their teachers, ought not our college or university, begin to "think on these things"?

Teaching and the Realities of Life

A world-known author has taken a look at education and found it "wholly inadequate to the realities of human life." He explains how students learn in spite of poor teachers. He sets forth some vital but neglected areas of teaching. The following article is an authorized condensation of the article "Can We Be Well Educated?" from Esquire, *December 1956, © 1956 by Esquire, Inc.*

By ALDOUS HUXLEY

Good art is everywhere a rarity, and good artists are overwhelmingly outnumbered by bad ones. Among other things, education is an art, and in the field of teaching, as in those of painting, composing and writing, mediocrity is the rule, talent and irresistible vocation the exceptions. In all my years at school and in college I made contact with fewer good teachers than can be counted on the fingers of one hand—two first-rate classical masters, one excellent teacher of biology, and one truly exemplary professor of English Literature. Four fine practitioners of the art of education out of the forty or fifty by whom, at one time or another, I was guided, instructed, and lectured at. This figure corresponds pretty closely to the world average—one reasonably good teacher in every ten or twelve, one educational genius in every ten to twenty thousand.

The surprising thing is not that the results of universal education should be so profoundly disappointing. No, the really surprising thing is that they are not much worse than they are. In actual fact the products of education by uninspired teachers are not nearly so bad as the canvases turned out by uninspired painters. The reason for this is simple and obvious. Canvas is mere dead matter, and can do nothing to make up for the ineptitude of those who daub it. Boys and girls, on the other hand, are very much alive and can, if they have the wit and the will, turn to good account even the worst educational artistry by even the dreariest pedagogue. A canvas cannot paint itself; but an intelligent and lively child can and does educate himself—in spite of bad teachers.

Those Who Have and Who Have Not

It goes without saying, of course, that children could educate themselves even more effectively if they had good teachers all the time. But even when exposed to only one good teacher in every ten or twelve, the best of them do remarkably well. But what of those children who lack the wit and the will to educate themselves in the teeth of all obstacles? For them the mediocrity of most of the artists in teaching is a very serious matter. A good teacher can inspire them to learn to the limits of their native capacity. Under poor teachers, they will learn next to nothing. As always happens in this most undemocratic universe of special intellectual privileges and inherited mental wealth, "to those who have shall be given, and from those who have not shall be taken away even that which they have."

Does it follow, therefore, that (except for those children who know how to educate themselves) ninety per cent of all education must always be bad education? Or is it possible, by means of organization and machinery, to make good the deficiencies of individual teachers?

Educational reformers have always believed that the right system, the proper organization, would solve all their problems, and they have advocated their respective schemes with the kind of confident zeal which we have learned to expect from religious sectaries. Each educational sect is convinced that *its* system will do the trick, and that the truth is not in any of the other systems. How is the inquiring outsider to choose between all these rival claims? On what evidence can he decide whether progressive education is better than classical education? Whether the Hundred Great Books are superior to Learning through Doing? Whether juvenile delinquency is a reaction to strict discipline or the result of too much permissiveness? Whether future engineers and chemists can learn more about the elements of science under a competitive system or under a noncompetitive system? To assess the merits of any system, we would have to isolate its results from the results of all the other influences affecting the lives of the children subjected to it. But in practice this is impossible.

The historical approach to the problem is no more enlightening; for we find, when we look back over the history of education, that the systems of training current during the most golden of humanity's Golden Ages were, by our standards, morally odious and intellectually absurd.

Thus, the subjects taught during the Middle Ages and even during the Renaissance were, to a great extent, not matters of fact, but matters of edification and literary amusement, and the methods of medieval and early-modern instruction were hideously brutal. Every boy was mercilessly beaten by his parents and schoolmasters, and the girls fared little better. Mothers—even such saintly mothers as the great Mme. Acarie—used regularly to flog their daughters; and when Abelard undertook the education of Heloise, he was authorized by her guardian to use the birch whenever he thought it necessary.

In the absence of any compelling evidence in favor of one educational system over all the others, the best we can do is to follow what remains of the humanitarian tradition in regard to discipline and, in regard to subject matter, to insist that all pupils shall have at least a nodding acquaintance with the sciences upon which the survival of an industrialized and overpopulated world depends; and, second, that they shall be made aware that there are other forms of literature and philosophy, of painting and music, than those with which the comic books and the advertisements, the juke boxes and television have made them all too familiar.

That there will be rival systems of education competing for the public favor is certain. But which of these systems gets chosen at any given time and place is probably a good deal less important than their respective advocates suppose. All that is important is that the children be kept interested and induced, whether by carrot in front or stick behind, to make at least some slight intellectual effort.

Greatest of Handicaps: Poor Teaching

It would seem, then, that no system can do very much to overcome the greatest of all educational handicaps—poor teaching. But this hitherto intractable problem might perhaps be solved, at least in part, by machines. Take the best teachers on every academic level, from kindergarten to college. Using all the resources at the disposal of the movie producer, set them to work systematically on a graded series of half-hour films, covering all the principal subjects in the curriculum. Let these films be projected in the classroom, with time to spare for the living teacher to comment and explain. Sporadically and on a small scale, educators are already making use of motion pictures and television in the classroom. The time has now come for these mechanical resources to be exploited systematically. As things are at present, children are exposed, on the average, to one good teacher in ten. Multiply the existing talent by machinery, and it will be possible to expose them to good teaching every day. What magnetic tape and vinylite have done for the playing of the musical virtuoso can be done by these and other recording devices for the teaching of the educational genius.

Nobody ever gets anything for nothing and, like everything else, higher education has its price. That price is pedantry. A pedant is a man for whom erudition is not the means to clearer thought, greater refinement of feeling, and more realistic action, but an end in itself, an ultimate good to be idolatrously worshipped. He exaggerates the importance of words and conceptual knowledge; he takes an unjustifiable pride in his mastery of the trivia and minutiae of his chosen subject.

Out of every ten learned men about seven, I should guess, become pedants. In ancient Greece, where higher education was hard to come by, there were, at any given moment of its history, perhaps a thousand learned men. Consequently there were only seven hundred pedants. In modern America, where every self-respecting township has its college or university, the number of learned men must be at least five hundred times as great as it was among the Greeks. Instead of a small battalion of seven hundred pedants, there is now a whole army, three hundred and fifty thousand strong, armed to the teeth with monographs, learned journals and tables of statistics, communicating, or failing to communicate, in the coded languages of professional jargon. The Ultimate Weapon of this formidable host is the doctorate—a device positively guaranteed to transform the greatest possible number of the young men and women exposed to its lethal radiation into fresh recruits for the conquering army of pedants.

Like the poor, pedants are always with us, always have been and, presumably, always will be. Nothing can be done to check the tendency of learned men to become pedantic. But something can definitely be done to change the system under which a doctoral thesis on some intrinsically unimportant topic, some tiny piece of nonsense totally irrelevant to everything, is made a passport to the teaching of a college course, let us say, in philosophy or English literature.

I have spoken hitherto of the problems of education as it exists today. But education as it exists today is wholly inadequate to the realities of human life. True, we all know that mere instruction is not enough, that children must be educated morally, emotionally, and physically as well as intellectually. We know this, and we try to do something about it. But what we do fails to produce the desired results. In spite of gymnastics and organized games, a large and apparently growing number of young men are found to be unfit for military service. In spite of our heightened awareness of psychological problems and the increased availability of phychological counseling, the neurosis rate appears to be on the increase. And so is the rate of delinquency, especially juvenile delinquency—and this in spite of all the Bible readings and the pep talks. Our aim is to foster self-discipline and inculcate self-control; but unfortunately the means we use don't seem to work.

Incidentally, they never did work, even in the palmiest days of orthodoxy. At periods when everyone firmly believed in eternal damnation, indulgence in the Seven Deadly Sins was as widespread as it is today. The legend of the man who sold his soul to the Devil, for all eternity, in return for a few years of sinful pleasure on earth is of Jewish origin and dates back to the beginning of the Christian era. Its popularity during the Middle Ages and (when associated with the historical Doctor Faust) during the century following the Reformation bears eloquent witness to the inefficiency of sermons, homilies, and dogmatic religion.

By and large, we have failed in our efforts to teach the young self-discipline, to train their bodies to be strong and healthy, to educate them in the art of controlling and directing their emotions. The reason for this failure is simple. We have neglected, more or less completely, to train the instrument, by means of which the human being must do his learning and his living, his thinking, feeling, and perceiving. We do nothing to educate the individual mind-body, nothing to bring the pupil's conscious self into effective harmony with the physiological intelligence or "vegetative soul." And yet it is the vegetative soul which has to do all the work of living. It sees to it that we breathe and digest, that our heart beats, our eyes see, our ears hear, our mind produces thoughts from the Unconscious. The self merely gives orders in the hope that the not-self with which it is associated will obey. In our maniacal preoccupation with words, notions, and the ego, we have neglected that larger and, one might say, cosmic part of every human being which lies below and above the verbal level.

The Special Senses and the Memory

Let us consider a few examples of our educational shortcomings in this direction. The special senses, as Professor Renshaw has demonstrated, can be educated so as to function with far more than the average precision, range, and rapidity. And the same is true of the memory. And yet, in virtually all our schools and colleges, nothing whatever is done to educate the special senses and the memory. Similarly we can, if we choose and if we know how, prevent the kinesthetic sense from becoming debauched and can learn, in the process, a large measure of what F. M. Alexander has called "creative conscious control." In John Dewey's opinion, this training of the kinesthetic sense is as necessary to education as education is necessary to the good life. Alexander's technique for achieving conscious creative control of the organism by establishing habits of right use and proper functioning provides the educator, in Dewey's words, "with a standard of psychophysical health, in which what we call morality is included."

Needless to say, John Dewey's advice, in this matter of educational fundamentals, has been completely disregarded. There is no school or college in which young people are taught the means whereby they can escape the debauchery of the kinesthetic sense which is almost forced upon them by our present mode of life; no educator teaches his pupils how to break their old habits of improper use and establish new habits of right use, no moralist does anything to help them realize that "standard of psychophysical health, in which what we call morality is included." Sunk themselves in kinesthetic debauchery, enslaved to the worst possible habits of self-use, hopelessly addicted to end-gaining and stone blind to the importance of the psychophysical means whereby the ends are to be gained, these educators and moralists continue to give their lectures, to preach their sermons, to write their empty rhetorical books about the Human Situation, and then wonder pathetically, or with ludicrous indignation, why, in spite of all their verbiage, things get no better, or even go from bad to worse.

Quis custodiet custodes—who will guard the guardians, how are our educators to be educated, our masters to be taught self-mastery, our pastors to be transformed from a flock of bawling sheep into accomplished and effective shepherds? That is the question. It is not being answered—indeed, by most educational reformers, it is not even being asked.

No man is the master of his fate; but the wise know how to collaborate with their destiny, how to swim with it and, in the act of swimming, direct its current in the direction they would like it to take. Fate works upon us not only from without, but also from within. A major part of every human destiny is the autonomic nervous system. It is associated with the self, but it is not a part of the self; for, as its name implies, it does its work independently of the personal will—and, when things go amiss with us, this independence is apt to turn into something like active hostility. Many perons are chronic martyrs to their autonomic nervous systems; and even the healthiest are often made aware, within the mind-body, of its alien and disturbing presence. By means of autohypnotic suggestion we can, if we choose, affect the workings of our autonomic nervous system, can cooperate with this notself which underlies our conscious ego, can induce it to help us in our daily tasks.

But in almost no schools or colleges are young people taught the simple psychological procedures, by means of which an individual can turn off pain and anxiety, implement his good intentions, intensively rest his body when it is fatigued, raise his resistance to disease, and speed convalescence after injury or sickness.

And finally we can, if we choose to use the appropriate means, shift our consciousness from its ordinary state of word-conditioned, belief-conditioned, memory-conditioned, anticipation-conditioned awareness to an immediate apprehension of total reality as it presents itself moment by moment in our relations with things, events, and persons; and we can learn to pass at will from this state of immediate total awareness to analytical, conceptualized knowledge of those situations where knowledge rather than understanding is desirable.

The art of being totally and immediately aware in circumstances where total, immediate awareness is necessary, and of being analytically and conceptually aware when it is necessary to know things in a strictly scientific and utilitarian way rather than in terms of beauty, love, or spiritual insight—this, surely, is the supreme art of life. That it should be taught in every school and college is obvious. But I need hardly say, it is never taught. A system of education which ignores this supreme art, and along with it all the other arts connected with the training of the mind-body, is incomplete and unrealistic. Its results will always be profoundly disappointing.

Educational Vistas of Television

"Teachers will make a grave mistake if they take an isolationist attitude regarding television. Here is an instrument which can spread education to all levels and all classes of society. Here is an invention which can make education truly dramatic and lifelike. In ignoring television, teachers will broaden the gap between school and society; in exploring the educational vistas of television and making it part of classroom instruction, teachers will make a formidable contribution to the betterment of our civilization."

FREDERICK MAYER
Philosophy of Education for Our Time
New York: The Odyssey Press, Inc. 1958.
Page 140.

Oliver Wendell Holmes Teaches Anatomy

This glimpse of Holmes as teacher enriches our familiarity with him as poet, physician-novelist, and humorist. The author (A.B., Quincy College; M.A., Ph.D., Illinois) has contributed numerous articles to journals, has taught in high schools, at the University of Nebraska and North Dakota State Teachers College, Minot, and is now assistant professor of English at the University of Alabama.

By ROBERT L. COARD

THE PROFESSOR'S CHAIR, Oliver Wendell Holmes wittily said in describing the isolation of the teacher in the midst of his students, "is an insulating stool, so to speak; his age, his knowledge, real or supposed, his official station, are like the glass legs which support the electrician's piece of furniture, and cut it off from the common currents of the floor upon which it stands." How did Oliver Wendell Holmes, poet, physician, essayist, and wit, acquire such an intimate knowledge of teaching? From long experience, of course, the only way such inside information comes.

Born in 1809, the lively little poet-physician, after graduating from Harvard and studying medicine in Boston and Paris, joined with three other physicians in 1838 to form the Tremont Medical School. The Tremont School, operating on a schedule that did not conflict with the four-month session that then constituted a medical year at Harvard, drew most of its faculty and student body from Harvard. The Tremont School furnished invaluable training to the wealthier and more conscientious medical student who wished to supplement his brief terms at Harvard with additional study. In 1858 the Tremont School was absorbed by Harvard.

Besides continuing his teaching at Tremont Medical School, Dr. Holmes was also professor of anatomy and physiology for two years at Dartmouth Medical School. Less grand than it sounds, this appointment in those days of lax educational requirements for the prospective M.D. actually meant that Holmes taught a combination of anatomy, physiology, and some chemistry for a fourteen week term in 1839 and again in 1840. In 1847 Holmes became Parkman Professor of Anatomy and Physiology at Harvard. From 1847 to 1853 in addition to his teaching duties, Holmes served as Dean of the Medical School and thus encountered those vexing problems that beset an educational administrator. He gave instruction in both anatomy and physiology—Holmes said he occupied a whole settee instead of a professor's chair—until 1871, when a separate professorship of physiology was established. Up to 1882, the year of his retirement, Holmes continued to teach anatomy. In "Some of My Early Teachers," his farewell address at Harvard, printed in *Medical Essays,* one of his most attractive volumes, the ever eloquent Holmes made a graceful reference to his thirty-five years of teaching at the Medical School: "I have helped to wear these stairs into hollows,—stairs which I trod when they were smooth and level, fresh from the plane. There are just thirty-two of them, as there were five and thirty years ago, but they are steeper and harder to climb, it seems to me, than they were then."

In order to appreciate Holmes' talent as a lecturer one must understand how youthful and obstreperous and ignorant was the audience the poet-physician addressed in his anatomy classes. James Clarke White, the pioneer dermatologist and medical education reformer, in *Sketches from My Life,* has vividly depicted the shockingly low educational standards of those days. To obtain a medical degree from Harvard in the mid-nineteenth century, one needed to attend only two ungraded sessions of four months a year, sessions that were often repetitions of each other. One also had to have his name registered as a student in a physician's office for three years, but this requirement did not guarantee that the student would apply himself to his books. Examinations were so easy that one had to be pretty much of a dolt to flunk.

To address three hundred of these noisy youths—"boys from East and West and North and South, from farm and desk and workshop and counter—many of them with education and manners only a grade above that of day laborers," as Dr. Stewart Lewis has described them in an article in the *Independent* for December 9, 1909—might well make the most experienced and forceful lecturer blanch. Think of the whispering and shoving, the snickering and guffawing, the late ar-

rivals and the early departures in such a heterogeneous and unruly mass! To add to his difficulties, Holmes got the students at one o'clock in the afternoon after they had been listening to lectures steadily since eight or nine in the morning. In the *Scribner's Magazine* for January 1895, Dr. Thomas Dwight, a student and later an assistant of Holmes, wrote a striking description of the students' exhausted and irritable condition at the hour for the anatomy lecture: "I lack power to express the weariness, the disgust, and sometimes the exasperation, with which, after four or five hours of lectures, bad air, and rapid note-taking had brought their crop of headaches and bad temper, we resigned ourselves to another hour. No one but Dr. Holmes could have been endured under the circumstances."

In spite of these formidable obstacles, Dr. Holmes was able to maintain his reputation as an inspiring speaker. He had, I think, too intense a craving for the excitement and ego satisfaction of holding a large audience ever to allow himself to fall into the droning lassitude of the perfunctory lecturer. To the task of instructing these fatigued adolescents he brought the endowments of the able teacher: a shrewd understanding of his audience, enthusiasm, learning, an appreciation of the theatrical niceties of exhibition and demonstration, and a gift of gab. Judging from the lectures reprinted in *Medical Essays* and from the statements of contemporaries, one can imagine coming from Holmes' lips a stream of anatomical information, mingled now and then with timely allusions, apt quotations, witty comparisons, and vile but effective puns.

In the first volume of his biography *Oliver Wendell Holmes: Life and Letters* (1896), John T. Morse Jr. has reprinted the testimony of Dr. David W. Cheever concerning Holmes' burning enthusiasm for his subject, that sine qua non of the good instructor: "And how he loved Anatomy! as a mother her child. He was never tired, always fresh, always eager in learning and teaching it. In earnest himself, enthusiastic, and of a happy temperament, he shed the glow of his ardent spirit over his followers, and gave to me, his demonstrator and assistant for eight years, some of the most attractive and happy hours of my life."

Though Holmes was learned and witty and animated, such a turbulent audience inevitably presented disciplinary problems. Holmes' solution of one of these problems, as narrated by Dr. Stewart Lewis on the authority of his father, shows Holmes' cleverness and keen insight into human nature. At the beginning of an anatomy lecture period, Holmes built up the curiosity of his audience by saying that on this occasion he had some unusual pathological specimens to exhibit. Pulling back the covering that hid the mysterious objects, he showed the pathological specimens—two heaping platefuls of spit-balls gathered by the janitor from the lecture-room floor. Launching into a peppery talk on wasted time and low ideals, Holmes then awakened in the students a sense of shame and remorse for their boorish conduct.

Although at times some of Holmes' brilliant students complained that he did not go deeply enough into his subject, it should be remembered that Holmes did not shape his lectures to their needs but to those of the average student. Considering the hour of the day and the educational attainments of the great majority of his audience, it is hard to see how Holmes could have done otherwise. Holmes' advice to teachers printed in the essay "Scholastic and Bedside Teaching" is worth quotation:

> My advice to every teacher less experienced than myself would be, therefore: Do not fret over the details you have to omit; you probably teach altogether too many as it is. Individuals may learn a thing with once hearing it, but the only way of teaching a whole class is by enormous repetition, representation, and illustration in all possible forms. Now and then you will have a young man on your benches like the late Waldo Burnett,—not very often, if you lecture half a century. You cannot pretend to lecture chiefly for men like that,—a Mississippi raft might as well take an ocean-steamer in tow. To meet his wants you would have to leave the rest of the class behind, and that you must not do. President Allen of Jefferson College says that his instruction has been successful in proportion as it has been elementary. It may be a humiliating statement, but it is one which I have found true in my own experience.

Surprisingly modern in the preceding quotation is Holmes' insistence on representation and illustration. Dr. Dwight bears witness to Holmes' careful preparation before the lecture to achieve the fullest visual effect: "Not only were many hours spent on the dissection itself, but every refinement of neatness and even elegance—clean sheets, careful draping, effective arrangement of specimens and pictures—received the most careful attention." If Dr. Holmes were alive today, I am sure he would be a capable lecturer on anatomy at the Harvard Medical School. I am also certain that he would be a noted TV performer with a high Hooper rating!

The "Dialog"

As Dr. Hatch continues his series of articles on the "Inquiry" approach to biology, we get here a detailed picture of "the Socratic Method in Modern Dress" as presented in these pages a year ago. "Our experience," says the author, "is that as soon as one mind lights up it excites and ignites others." Does not the success of these voluntary dialogs reveal unmistakable sincerity of purpose in students?

By WINSLOW R. HATCH

SOME TEN YEARS AGO we started experimenting with a discussion-type meeting, in a science course, of all places, and today find it the most satisfying classroom experience we have known. The students come to our conferences even though they are offered on a voluntary basis, and come to so many that it is embarrassing. The following description of a sample conference or two is dedicated to the proposition that teaching is an exacting business.

Our method in conference is to think and talk in groups of sixteen, twenty, or occasionally thirty-five to forty students. This thinking and talking does not take the form of a recitation or a "lecturette." It is not a question and answer session or one of Mr. Rogers' nondirected discussions. It does not employ the case method.

Our first halting efforts with discussion took the form of recitations, because this was the only kind of discussion we knew from our own experience. This kind of discussion was abandoned, but its substitute was no better, for we found ourselves relapsing into small lectures or "lecturettes." The "question and answer technique," meaning for us at least, a more or less catch-as-catch-can series of questions raised by either the students or instructor was disappointing. The discussion, if it could be so called, was all too often formless. It did not go any place; particularization overcame generalization. The nondirective technique in our unskillful hands had a habit of relapsing into street-corner conversation. This experience brought us to a kind of discussion that auditors from the humanities program labeled Socratic. Our main concern in our conferences, call them what you will, was that there be a pattern, a pattern running through each and all of the discussions, and that the discussions be supported very largely by the students.

The pattern is instructor-student-instructor-student, and while it might be feared that in this type of discussion light may flash in only one mind at a time, our experience has been that as soon as one mind lights up, it excites and then ignites others. The questions raised and the statements made in answer to them are usually short, so that the discussion is smartly paced. A difficulty which plagued us at first was that we were unable in an hour's time to develop adequately the concluding statements which we felt to be necessary. By sustaining a pattern from conference to conference, week after week, however, the generalizations that one is unable to make in one meeting can be made at the beginning of the next—and perhaps be made better, because the students have had a chance to think in the meantime. The liveliest discussions are often those in which the students discover the inadequacy of an hypothesis to which they have been originally attracted. By being alert to the unexpected twist that students give a discussion, to the original, even to the irrelevant comment, the teacher can guide without leading. The leader also makes every effort not to let his predispositions show or to expose the contradictions in students' arguments. With the right nudge at the right place, the students are able to expose them for themselves.

An advantage in a Socratic discussion, as far as we are concerned, is that, should the teacher overplay his role, the corrective is ready at hand. The students resist "being led." To resist, however, they must supply good alternatives, and so they are involved even more. The fear that some students may get lost at the first turn of the discussion and so be unable to profit from the rest of the conference is real. Our solution, and it seems to be a good one, is to invite such lost souls to audit other conferences until they can follow the discussion to its conclusion. This they do in unexpected numbers; there are often ten to fifteen auditors at a dialog, and some, entirely on their own initiative, attend three or four additional dialogs a week.

The preparation for a dialog probably has

more to do with its success than anything that transpires in it. First of all, the student must appreciate that he had a hand in the choice of the problem, that he was a party to its analysis, and that he helped in the design of the study; that in the laboratory he was really on his own. He must have read on the subject; he must have his facts. The instructor has another kind of preparation to make. He has to change places with the student as best he can, and try to estimate how the problem appears to the student. He must identify those associations which the student can be expected to make, those analyses that should be within his reach. With his opening questions, he determines how accurate his estimate was and raises or lowers his sights accordingly. The good discussion leader develops a sensitive ear for the unique contribution. Even the one with little virtue in itself can often be rephrased and used. He is even more attentive to the substantial and the original contribution and welcomes it with obvious appreciation. For the student who resists the direction taken by him, he develops real affection. If he can get this student to challenge his logic, it is made unmistakably clear that the initiative rests with the student. If he can encourage the students to develop alternative hypotheses, or if he can get them to discover for themselves the inadequacies of a hypothesis to which the class has been attracted, the role of the discussion leader can be "played down." While the instructor should have some idea of the pattern he hopes the discussion will take, of the general strategy, the development of the discussion (the tactics) should be determined by the students.

The problems explored in these conferences have been anticipated, we should perhaps repeat, by:

- Student reading of the lecture notes of the last year in which the lecture served as the place where facts were presented, presumably for the first time. Edited and up-dated each year, these lecture notes constitute the minimal body of fact necessary to an intelligent discussion.
- A lecture in which the problem has been stated and analyzed and the student's facts organized.
- A laboratory in which the students have seen the form some facts take and where some tentative interpretations have been made on the strength of their own observations.
- Reference work. While the students are given no assignments they are told that they may provide themselves with textbooks if they wish. The most worn sections of these books, when used, are the indices and glossaries. A reference shelf is also maintained in the library, but no reading lists are supplied. While the reference librarian helps the students find what they think they need, following their search wherever it takes them, he is careful not to provide the students with answers. Having audited the course, the librarian understands what we are trying to do.

To sum up: the questions asked, be they in lecture, laboratory, or dialog, have not been answered in advance by the teachers in the course. Nor can they be supplied by students who have taken the course because the basic problems are never phrased in the same way and the route to them differs, not only from semester to semester, but from laboratory to laboratory and from dialog to dialog. Neither can the questions be neatly disposed of by pat answers found in textbooks—not if the instructors can help it or identify them. The pat answer is rather easily identified and, when it is, it is dismissed with sufficient curtness to discourage this substitute for thinking.

It is not easy to capture the smile of satisfaction of a student who has thought his way through to his own answer. Nor is it easy to catch the zest of a conference. The reader is asked to try to imagine the give and take of the conference from the paler version of it that is all that can be given in print. The dialogs here presented required five meetings. But no reader has the time to read five hours of discussions; so the dialogs have been condensed considerably. We trust, however, that they are still reasonable facsimiles. As a sample, we have selected "Man in the Making," which takes three meetings. Its companion piece, "How Does an Apple Tree Happen," takes two.

Dialog: Edited Transcripts

Man in the Making

From a few chance remarks dropped here and there, remarks that perhaps were judiciously planted, I have the distinct impression that you stand somewhat awed as you view the woodpile which we are supposed to saw up this week. In the lectures Dr. Buechner took you out to the woodshed and in diagram after diagram and in tissue after tissue piled up what must look like a king-sized cord of wood. While man is a lazy brute, there are some satisfactions that are not likely to be gained in any way except by work, and there are some satisfactions in intellectual labor that are among the "durable satisfactions of life," as Charles W. Eliot put it. The satisfactions I have in mind are to be found in the solution of two problems which you faced in the first lecture on human embryology: (1) How does a man happen? (2) Why does he happen in the way he does?

It would not be unnatural for you to conclude that a man happens in his first nine months plus some 20 years of growing up. That one should know something about what happens during this period goes without saying, and if we had not allowed our natural curiosity about "where little girls come from" to dry up we would want to know something about it. This is one thing "that every young man should know," but I would like to suggest that man

started to happen long before any individual present was conceived. Man has been happening over some hundreds of millions of years.

It is not often that one gets such a fine return on his investment as when he studies human embryology. Most of you as you study your lecture notes see nothing before you but a series of diagrams and a new involved terminology. To see in human embryology the significance that lies in it you need to put on three-D glasses, and these we can supply in the form of the *theory of recapitulation.* Today a lot of very discouraging things are said about theories and theorists, but a theory makes sense out of a great deal of nonsense, and certainly today anyone who makes sense out of nonsense is a pretty useful as well as a pretty rare character.

As we grope our way through human embryology we find ourselves confronted with a baffling array of plates, sacs, cords, columns, tubes, arches, and chambers. It may be helpful to remember that archaeologists who excavated the monuments dotting the Nile Valley were faced with an equally baffling array of dots, lines, and odd raised figures. By chance one of Napoleon's soldiers stubbed his toe on a curiously inscribed stone near Rosetta, Egypt, and from these inscriptions M. Champollion was able to provide a translation of hieroglyphics. Since his interpretation in the Rosetta stone, Egypt has had history. We may look upon the Theory of Recapitulation as the biologist's Rosetta stone, since with it man discovers his own history. This is not the only evidence that man has of his early origins, but it is evidence that has been etched into man's own protoplasm, and when we know where to look and how to look, we discover how man happens and why he happens in the way he does. We can, in the same print and on the same page, as it were, read the history of the development of both the individual and the species.

The story of how man happens from conception to birth can be told in diagram after diagram, and this "outline of history" should now be transcribed into your notebooks. But why does man happen in this way? Even those of us who are not very critical find ourselves asking, "Why does man have an appendix?" It does not seem to serve any useful function, and for some of us it is a luxury that we can ill afford. An appendectomy can be expensive, and before we knew how to diagnose and treat appendicitis, the appendix was a killer. That "inflammation of the bowels" that appeared in the obituary columns of yesterday's newspapers was usually appendicitis.

Why an appendix?

Why does man have gill pouches? Does he have any use for gills?

Why does he have a yolk sac? He doesn't use his yolk sac; he forms one, cuts it loose, and gets his nourishment from quite another source.

Man discovered the theory of recapitulation by asking himself these questions.

Why does a man have an appendix, gill pouches, or yolk sac? This is the sixty-four-dollar question. But it is only a thirty-two-dollar question when we put it this way:

"Why does man have blue eyes or a fine aquiline nose?"

Now we have it—

"Because he has genes for them, genes for blue eyes or any other structure."[1]

Any other structure, like appendices, gill pouches, yolk sacs?

"Could be."

Must be. But where does man get his genes for eye color, shape of nose, or a predisposition to appendicitis?

"From his parents or grandparents, his ancestors."

True enough, but why should man fabricate structures without any utility in his economy, structures that may even be a decided debit? The development of a single structure, the heart, is a case in point. Why does a human heart develop in the way it does?

Why in early embryological development does the simple circulatory system consist of a two-chambered heart and then progressively a three-chambered heart, a three-and-one-half-chambered heart, and then finally the four-chambered heart we associate with the adult body? We would not build a house this way. If our family required four rooms on the first floor, a living room, dining room, kitchen, and bath, and the builder understood this, it would be irritating, to say the least, if on visiting the new home, we found that he had built just two rooms. We would not think him very bright. We would be convinced of his stupidity if, having made our remonstrances and after having been very pointed and very emphatic in our remarks, we returned two weeks later to find that he was well on his way to building three rooms. If after another heart-to-heart talk, he only added a partition to one of his rooms, a partition that only partly closed off the bathroom, you would be convinced of his stupidity, or perhaps cupidity. A bathroom with no privacy is just a little odd; so you would insist upon four good rooms. This would be a completely illogical and uneconomical way to build a house, and yet this is essentially what happens in the development of the heart.

Why does a man happen in the way he does?

Already we have found in our woodpile two planks of an evolving hypothesis—namely, that man has the embryological structures he does because he has genes for them, and second, that he gets these genes from his ancestors. Let us explore the implications of these two statements and see if we cannot find a third plank needed to support a theory of recapitulation.

Ours is a four-chambered heart. You have helped to prepare the Thanksgiving turkey and you have cleaned a trout or two; what animals have four-chambered hearts?

"Man, other mammals, and birds."

If man, the other mammals, and birds have four-chambered hearts, they have genes for them, and they received these genes from ancestors, and the ancestor contributing these genes must have been some prehistoric animal in the vertebrate branch of the tree of life just below the mammalian and the avian crotch (among the fossil reptiles). [A sketch of such a "tree" is constructed as we talk. Some of the references are to this sketch.] The mammalian branch, of course, divided a good many times before it formed the ape and man twigs, and so did the avian branch. Let us locate this ancestor as a short section in the premammalian, preavian branch—in bright red chalk. The three-and-one-half-chambered heart found in man, mammals, and birds, albeit in their embryology,

[1] The italics indicate the students' responses.

is also found in many adult reptiles. This suggests that these animals may have . . . ?

"A common ancestor somewhat further down the vertebrate branch below the reptilian crotch."

Let us locate this ancestor. And then there is the three-chambered heart which we find today in . . . ?

"Adult amphibians."

We also find it in the embryonic development of reptiles, birds, mammals, and man. Genes for three-chambered hearts have presumably been inherited from some ancestor in the vertebrate branch at a level marked by . . . ?

"The departure of the amphibian branch."

The two-chambered heart found in embryos of amphibians, reptiles, birds, mammals, and man is also found in adult fishes. This would suggest . . . ?

"A common ancestor in the vertebrate branch just below the point where the fish branch grew out."

The vertebrate branch of the tree of life which we are sketching is not an intact branch; it is a series of short, widely separated sections of a branch; but these sections, taken together, do outline the branch and suggest the pattern of its branching.

One can do this very same thing that we have done with the development of the heart with the skeletal system and the central nervous system. Can you? If you cannot, you had better do it tonight on your own time using different colored crayons. When you are done there will be fewer gaps in and considerable reinforcement of the pattern of branching of this part of the tree of life. If you are still not convinced, line up your facts regarding pro-, meso-, and metanephros in vertebrate embryology, human and otherwise, and see what they do for your tree of life.

* * * *

The phylogenetic tree we were working on last week consisted of a single, mighty branch. Today let us see if we cannot build a trunk under it by continuing to use the evidence of embryology.

Before any of the systems considered last time—the circulatory, the skeletal, the nervous, and the excretory systems—were differentiated, there was still an embryo. While the differentiation of the human embryo at this stage is not great, one can at least identify three layers of cells in the embryonic plate.

What are they?

"An ectoderm, an endoderm, and a mesoderm."

Structures require genes, genes require an ancestry. What would this structure suggest?

"That there must have been an ancestor with genes for this three-layered condition."

And in the embryonic process before we had three layers we had two.

Which two?

"The ectoderm and endoderm."

Where today do we find two-layered animals with little differentiation of these layers?

"In simple two-layered invertebrates."

We are then approaching the trunk. In the embryological process, before there was any differentiation into ectoderm and endoderm, there was a common mass, a blackberrylike mass, which is sometimes called a morula. This could mean that man may have had an ancestor with genes for this kind of organization—an organization which we associate today with . . . ?

"Colonial protozoa."

And so we carry this branch to, or very nearly to, the trunk.

Now let us stand back and study our phylogenetic tree on the one hand, and the embryological process on the other. In the embryological process we move from the two-chambered to the four-chambered heart, from notocord to the anthropoid spine, from neural tube to brain and spinal cord. And there is a definite pattern of progression of two-, three-, three-and-one-half-, and four-chambered hearts, for example. When we study the tree of life, we are able to locate the ancestors who contributed these genes to our blood lines. Where have we located the common ancestor who provided the genes for the two-chambered hearts?

"Way down there." [The reference is to a chart on the board.]

And where have we located the ancestor who provided the genes for three-chambered hearts?

"There."

The three and one-half?

"Up there."

And the four-chambered heart?

"There, near the last branch."

We locate the two-chambered ancestor in the oldest branch, and then, progressively moving upward, we locate the three-, three-and-one-half-, and four-chambered ancestor in more recent and lesser and still lesser branches. There is again a progression and a pattern. We can now nail down the third and final plank in the theory of recapitulation. What is it?

"In embryological development, structures appear in the same approximate order in which they appeared in evolutionary development."

You now have all it takes to write your own statement of the theory of recapitulation. Bring it with you next week.

We are, I hope, far enough into the subject of embryology so that we can see that it is a kind of documentary film in which a lot of frames have been lost. The record, then, is far from complete, and sometimes even where we have the film it is so altered as to be difficult to interpret. There is a dramatic sequence in this documentary film we call "embryology" which we should look at before we call it quits. It might be entitled, "The Migration of Animals to the Land."

If animals migrated to the land, where did they come from?

"From the water."

What is the evidence that man and land animals had an aquatic origin? What is there about a man today that suggests that he has an aquatic ancestry?

"In man's embryology he still has gill pouches."

That's one—What else? What about his reproduction? No? What about his gametes? Still no spark? What about the male gametes; do they crawl around on four legs or fly like butterflies?

"They swim."

In an aquatic habitat sperm could be discharged into the water and swim directly to the egg. Primitive aquatic animals did not have to copulate. Let us try to find the real answer to the question—"What is the advantage to land animals of copulation?"

"It places the sperm in a place where it can swim to the egg; otherwise it would be left high, dry, and hopeless."

Copulation, then, is one of the adaptations that land animals had to make in order to stay on land. What other adaptation do we find in the embryological record itself? Aquatic animals were capable of sexual reproduction, eggs were freed in the water, fertilized in the water, and the embryo developed in the water, but when the animal left the water the "female-animal" carried the egg or eggs with her, and the embryo presumably had to develop in a nonaquatic habitat.

But does it?

"No, it doesn't—it still has its own little pond."

What additional adaptation did land animals have to make?

"They had to develop an amnion and as a consequence an amniotic sac; they carried the water with them, the embryo never left the water."

What other adaptation did animals have to make to leave the water and carry on their life processes in an aerial environment?

"They had to develop lungs."

But where did lungs come from? Some pre-existing structure had to be adapted to this new use. According to the embryological record what pre-existing structure was adapted to serve the function of lungs? Where did lungs come from? Where do lungs come from in our development? From what?

"They are an evagination of the digestive tract."

"They are modified digestive tract."

That animals have changed and that organs have changed through the long years seems to be clear even from the facts of embryology. Let us have a look at the rate of change. It took animals a long time; it may have taken them a hundred million years to evolve from the single protozoan cell to the multicellular state. Why did change come so slowly here?

"There was no sexual reproduction."

How does sexual reproduction contribute to change?

"It increases variation."

But how does sexual reproduction increase variation?

"Sexual reproduction compounds genetic change."

But how is genetic change brought about by sexual processes?

"It is brought about by meiosis and karyogamy."

What happens in meiosis?

"Segregation."

What happens in karyogamy?

"Recombination."

Is this change brought about by sexual reproduction advantageous, disadvantageous, or neutral?

"It is not one; it is all three."

How can change, chance, or random change be made advantageous to organisms?

"Through the action of the environment, natural selection, survival of the fittest."

Enter the environment! But animals changed faster on the land than they did in the water. Mammals have only been with us for 200 million years, and see what they have done. Why? Why faster change?

"Sexual reproduction."

That was a good answer before, but it will not do here. Aquatic organisms were also capable of sexual reproduction.

"If there is an internal, a genetic change, and the environment of the old and the changed individuals is the same, any change is likely to be for the worse, or at least, may not be a change for the better. If the environment is different, if there are different niches in it, the changed individual may be adapted for one of these niches— better adapted than the old individuals—and so change is perpetuated."

But, all of a sudden, new genes appear in the evolutionary stream, genes for a notocord, genes for two-chambered hearts, genes for neural tubes, genes for an amnion, genes for lungs *et al.* Where do these genes come from?

"Mutation."

* * * *

We are ready now for your statement of the theory of recapitulation. You may want to assign it to perdition, but what is your statement?

"Ontogeny recapitulates phylogeny."

Where did you get that handsome phrase?

"From my high school biology teacher."

Do you know what it means? What is ontogeny?

"Embryological development?"

Is it just embryology, or is it more inclusive?

"It's development."

And that is what it is. In the plant we will need to broaden ontogeny to include developmental processes over and beyond the embryological ones; so it is well to be clear that we are talking about development. But are we clear on what development is? Development is a kind of what—what physiological attribute of living things is manifested in development? In a sense, several of the physiological processes contribute, but which one makes the major contribution?

"Growth."

But what is growth, and what is growth *in man?* What is the technique of growth used by man in the developmental process?

"Growth is achieved by cell division plus synthesis of new protoplasm."

Did you put a period after that?

"It's cell division and free-nuclear division plus synthesis of new protoplasm."

How do you know that free-nuclear division is also involved in man's development?

"Striated muscle and heart muscle are noncellular, in our use of the word."

What is the difference between cell division and free-nuclear division?

"Cell division involves mitosis and cytokinesis; free-nuclear division involves only mitosis."

There is then something common to both?

"There is."

What is it?

"Mitosis."

In our process of development, we have seen something besides free-nuclear division and cell division; man is not simply a mass of cells or a mass of multinuclear protoplasm. These cells differ as striated and heart muscle differ. What is your explanation for the fact that cells differ, that smooth muscle is different in structure and function from bone cells, from nerve cells? Why is heart muscle different from striated muscle?

"These different cells have different genes."

Now just how good an answer is that? Is that the explanation? How can you be sure that it is *not* the explanation. We were just talking about cell division and free-nuclear division, and we noted that both have nuclear division in common, a type of nuclear division we call *"mitosis."*

And the one thing that we know about mitosis is that . . . ?

"It perpetuates the same number and the same kinds of chromosomes; the same number and same kind of genes."

So if all nuclei in the body are traceable by mitotic divisions to the original zygote nucleus, all the nuclei in the body must have the same complement of chromosomes, of genes; the cells must then have the same genes. There must then be a difference in the way these genes are "expressed" in different parts of the body. All right, enough for today, but this sets the stage for our next "dialog," next week: "Man and His Internal Environment."

I would, however, like to add an appendix at this point.

"Man in the Making," has been a discourse upon change and has dealt with how man changes and why he changes. Our problem now is "Whither Mankind," appropriating the title of another book! The Greek oracle bending over sheep entrails was supposed to be able, with these biological materials, to divine the future. Lacking a knowledge of biological principles, theories, and hypotheses, he was, however, wrong as often as he was right. Using biological insight rather than the oracle's eyesight you can be pretty sure of the process, if not the end result, of man's evolution through a future age, which future historians may identify as the atomic age. What biological processes will see man through this age and the next 50,000,000 years?

How Does An Apple Tree Happen

When does an apple tree start happening? We have all heard the old saying that great oaks from little acorns grow. We all know what an acorn is, or think we do. The clear inference, while not entirely correct, is that oaks begin as acorns. But does an oak or apple tree really start happening with the germination of the seed?

"No."

A seed has a history; the embryonic apple tree in the seed has a history; as a matter of fact the apple tree is well on its way to happening in the seed. This follows because an apple seed has a well-developed embryo, and since embryos have a history, the apple tree must have a history, that antedates seed germination. When does the embryo begin to happen?

"In the zygote or fertilized egg."

But the zygote by its very name suggests that it has a history; there has to be a "yoking" of something. What is it?

"A yoking or fusion of male and female gametes."

But did the apple tree begin to happen with these gametes? One might begin one's account here, but it would be a little odd, and scarcely decent, to leave these gametes hanging in the air. Where, in an apple tree, would you locate a female gamete?

"In an embryo sac."

And where do embryo sacs come from?

"I don't know where they come from, but embryo sacs can be traced back to megaspores."

Perhaps then an apple tree begins to happen with the germination of this spore. Where do male gametes come from?

"They are found in pollen tubes; pollen tubes come from pollen grains, and pollen grains can be traced back to microspores."

There is then in this, the male line, a reiteration of the word *spore*. Where and when do apple trees begin to happen? Not with seed germination, not with the zygote, not with the gametes. It might be . . . ?

"These spores."

An apple tree has spores? Let us stop here for a minute. Apple trees not only have spores, but their spores come double—microspores and megaspores. Why, then, do we not speak of an apple tree as a "spore plant"? What do we call it?

"A seed plant."

Let's straighten out our thinking about seed plants. Discovering spores as we have in apple trees, emphasizes that seed plants have spores as well as the "lower" or lesser plants with which we usually associate spores.

But does the history of an apple tree begin with the spore, the micro- or megaspore? Does an apple tree happen only during the time a seed is forming, or while these seeds germinate into seedlings? Does an apple tree happen only in the period from May to September, or at most the first one, two, three, or four growing seasons? Is the history of an apple tree written in four months or four years?

From our knowledge of man and from the nature of the answers we pieced together to the self-same question about man—"How does a man happen?"—we know that we presumably need to take into account here in the tree the likelihood that an apple tree has a history that reaches back even beyond the spores into the past; that how an apple tree happens today may be explained in part by how it happened through eons of time—that an apple tree presumably has been happening for hundreds of millions of years.

We have our facts as they bear upon the development of the gametes and gamete-bearing structures, the development of the embryo, and the establishment of the seedling. We have these facts, and they can be diagrammatically represented on the blackboard. Our problem, however, is to build a history under this apple tree, a history that goes back to the spore, a history that reaches back some hundreds of millions of years. Let us see if we cannot think our way back to some understanding of the history of an apple tree. We do not know that the history we are discovering through an interpretation of the facts of development is a true picture of the history of an apple tree, but we can with some confidence, create and populate a past with primitive ancestors of modern flowering plants, and hence of apple trees.

First, we have reason to believe that apple trees, or at least land plants, had an aquatic origin, but you will not discover the answer in the embryology or morphology

of an apple tree. When we were studying man, we found evidence of man's aquatic origin in amniotic sacs, motile sperm, and gill pouches. Apple trees do not have gill pounches, amniotic sacs, or gills; so where might you find a shred or two of evidence? While flowering plants do not have motile sperm, some land plants do have such male gametes. This is the case with some coniferous plants, with ferns, mosses, and liverworts.

Why should land plants such as ferns, mosses, and liverworts have motile male gametes?

"Because they have an aquatic ancestry."

Let us take a new look at the development of an apple tree and see if we cannot begin to write some notes to ourselves, so that we can eventually use these notes as an artist might to piece together a picture of a theoretical first land plant. While artists have to "feel" their subject, we have to "think" our way through to ours. We have our facts in a 1958 model of an apple tree, but you have to have a good nose for these facts to find the ones we need in this analysis. How are we going to find the facts that create a history? One way is to take the facts, the diagrams we put together in lecture, and place then in a kind of "developer" to see what kind of picture they give of the ancestry of an apple tree, of an original land plant. what was the "developer" we used to discover man's history?

"The theory of recapitulation."

On the board between the white brackets are all the facts and diagrams we need from spore to tree. What is the process included between these two brackets?

"Ontogeny or development of the individual."

Over here is a space for that "outline of history" we mean to write and illustrate. To the far left are the waters of the ancient sea, and rising from its low shores and growing on these shores there is to be a plant. Climbing out of this sea and on toward the ceiling is a stairway that leads to an apple tree as we know it today, complete with stem, root, leaf, flower, fruit, and seed. What is this process that begins with the first land plant and ends with an apple tree?

"This is phylogeny or the development of the species."

And the theory of recapitulation states that ontogeny repeats phylogeny. If we now take up our second question, "Why does an apple tree happen the way it does?" and paraphrase this question, "Why does it have some of the structures it does?" we may be able to get ahead with our history. There are some rather inexplicable structures in an apple tree. There is, for example, the embryo sac. Most of you think you know what an embryo sac is: "An embryo sac is an embryo sac,"—that is the way you memorized it. But what *is* an embryo sac? Is an embryo sac something new, new to flowering plants, something that lower or lesser plants lack? What *is* an embryo sac? Let us check over the embryo sac. It has its female gamete, its three antipodals, its two synergids, not to mention the two polar-nuclei. Where did the six cells and the two nuclei come from?

"They came from a smaller sac without any cells, with just eight nuclei."

And this eight-nucleated sac had its origin in a smaller sac with four and then two and then a sac or cell with just one nucleus. And what do we call this uninucleate sac or cell?

"We call it a megaspore."

We have discovered the spore all over again. To see what is happening here we need to see what happens in a liverwort, moss, or fern. Let us take a somewhat misnamed "spore-bearing" plant such as a liverwort, and let us take *Anthoceros,* a plant you have seen in the laboratory. The spores of *Anthoceros* fall on the ground and germinate into a dissected, lobed sheet of crisp, green tissue which we call a thallus. This may be one or two inches in length. Spores of a so-called spore-bearing plant, then, germinate to produce thalli, and they do it by cell division; by mitosis and cytokinesis. What happens to a megaspore in an apple tree?

"The nucleus divides mitotically until eight nuclei are formed."

Mitosis occurs in the growth of the megaspore and some cytokinesis follows mitosis, producing six cells. This spore, a megaspore, experiences mitosis and cytokinesis. What is this process? Mitosis plus cytokinesis equals what?

"Cell division."

Only here the spore does not crack open. This is then a sort of internal germination; the megaspore germinating internally to produce an embryo sac. What is an embryo sac?

"An embryo sac is a germinated megaspore."

Now if an apple tree has an embryo sac it has genes for an embryo sac, and if it has genes for an embryo sac it had ancestors that had an embryo sac or its reasonable equivalent. If its reasonable equivalent is a germinated megaspore we can write our first note to ourselves. The ancestors of apple trees must have possessed spores that germinated to produce a something. If it was not an embryo sac, what was it?

"A thallus of some sort."

And what is a thallus? You don't know? Well, an apple tree, as you know it, is a cormus. What is the difference between a "cormus" and a "thallus"?

"An apple tree, a cormus, has stems, roots, and leaves; the thallus of a liverwort, or a fern, or of an apple tree lacks stems, roots, and leaves."

If the thallus of *Anthoceros* is large enough to be seen without a microscope and some thalli may be as big as dinner plates, we can conclude that the thallus of the ancestral plant was probably macroscopic also, perhaps three to four inches in diameter. And now we can ask some really embarrassing questions of the embryo sac. Why do you suppose it has synergids? These two cells serve no function today; they stand beside and arch over the egg, but the egg does not need attendants. And after fertilization these synergids break down and disappear. Why does an embryo sac have synergids? You should be used to this sort of question now.

"Because apple trees have genes for synergids."

And why do they have genes for synergids?

"Because some ancestor supplied them."

Some ancestor of the apple tree like our distant ancestor, the one we are working on? What is a synergid, really? We may get some help in this if we study one of the thalli we have been talking about, the thallus of a liverwort, and give it some thickness. Embedded in this thallus is a curious flask-shaped structure with a female gamete nestling in its base. What would you call this

structure? If the suffix "angium" means "covering" what would you call it?

"It must be a female gametangium."

All right, the female gamete is surrounded by a female gametangium on all sides and arching over it. In the apple tree the synergids stand on either side of the female gamete and arch over it. It would be permissible, then, to suggest that perhaps the synergids represent a reduced or vestigial . . . what?

"Female gametangium."

Since synergids may be female gametangia, a primitive ancestor of the apple tree may well have had, not synergids, but female gametangia. Let us add another note—"Draw a female gametangium."

And then there are the antipodals. They are there; we memorize their name, but is that all there is to it? If we put antipodals through the developer we call the theory of recapitulation they may also give us some clues as to the nature of this ancestor of apple trees. Apple trees have antipodals, they have genes for them—and they got these genes from some ancestor, perhaps the one we are working on right now. But are we necessarily going to draw antipodals in our ancestral plant as three small cells? Perhaps we might better ask what, really, do antipodals represent. When the Anthoceros spore germinated it formed a thallus and in that thallus was a female gametangium. We have suggested that we should draw a female gametangium, but are we going to leave that gametangium dangling in the air? If the megaspore germinates to form an egg and synergids at the same time it forms antipodals, and if the synergids represent a vestigial female gametangium, what is there left for antipodals to be but . . . ? In the liverwort, what did the spore form besides a female gametangium and an egg? What is the tissue in which the gametangium is located? What do you suppose antipodals are?

"Thallus."

Yes, they would appear to be a reduced or vestigial thallus. So we write another note, "Draw a thallus." If antipodals represent the vestigial thallus of some primitive plant this thallus presumably should be larger than three cells. Why?

"Vestigial structures, by their very name, are smaller than the original structure."

In the drawings developed during the lectures and redrawn here, there is an innocent looking little cell—*this* one. Fearing that you would completely overlook it, we have dwarfed it with a big asterisk, a question mark, and an exclamation point. This is the antheridial cell in a pollen grain. But what in the world is a pollen grain? Where do pollen grains come from?

"A pollen grain is a microspore."

Wait a moment! It looks something like a microspore, but we do not call it a microspore. Why do we have to have a different name for it? Why call it "pollen grain"? How does a pollen grain differ from a microspore?

"It has two nuclei, one free in the pollen grain and the other in a cell of its own, the antheridial cell."

Megaspores germinate internally to form embryo sacs. What do microspores do?

"Germinate internally to form pollen grains."

What is a pollen grain?

"A germinated microspore."

Now what is this antheridial cell? You don't know, but already some of you must have begun to worry about our primitive plant; it had a female gametangium, but no male gametangium. In present-day liverworts we have male as well as female gametangia. Where are the male gametangia in the liverwort, *Anthoceros?*

"They are embedded in the thallus and the male gametangia are sort of lemon-shaped structures."

Right, and they have a wall, and are relatively massive, with a great many male gametes. If male gametangia produce male gametes and an antheridial cell by cell division produces two male gametes, what do you suppose an antheridial cell is?

"Probably a vestigial or reduced male gametangium."

That is how it came by the name antheridial cell. Our technical name for the kind of male gametangia found in liverworts, mosses, and ferns is antheridium. Perhaps you are a little tired of thinking and would like to draw; so let us go back to the seashore reaching out of that prehistoric sea and draw an ancestral apple tree, following our own directions. There had to be a spore; let us draw it. This spore had to germinate, forming a thallus; at least we were told to draw a thallus and to make it big. Let us draw it to scale—let us draw a thallus two to three inches long. And there should be, we have said, a female gametangium. Let us draw one. But where shall we put it? Imbed it if you wish. And our notes say there should be a male gametangium. What shall we do with it?

"Imbed it."

As you stand off and admire your work, you say this does not look much like an apple tree. No, it doesn't. We are only drawing what our reason and the theory of recapitulation tell us to draw. What is the generation represented in this primitive plant—spore to thallus and gametangia? You don't know. Well, what is the generation represented in our life cycle of the apple tree that begins with a megaspore or microspore and ends with an embryo sac or a pollen grain, with a female gametangium, with a male gametangium?

"That's the haploid generation."

What do you suppose this is?

"The haploid generation."

Most of an apple tree as you know it is diploid, or stated somewhat more accurately, the thing you have taken to be an apple tree is diploid. Does *this* plant, *this* generation, have no history? Let us start with the shoot. But what are we going to write as a note to ourselves—"Draw a shoot"? Someone is certain to ask, "What is a shoot?" What is it?

"Stem and leaves."

But whoever is asked to draw this theoretical plant is almost certain to ask: "What kind of leaves shall I draw?"—leaves like pine needles, or like apple tree leaves, or like the leaves of a burdock?" Let's not be too quick with our answers. If ontogeny repeats phylogeny and you take into account the onto-genetic development of apple leaves, what would it have to be? Leaves are formed on a stem-growing point; first there are leaf-rudiments, mounds on the stem-growing point, then cylindrical bent fingers, and only in late development does the flat, broadened portion develop, the thing we call the blade of the leaf. Before we had a leaf, or at least before we had

anything we would recognize as a leaf, what did we have?

"We had a leaf rudiment, a cylindrical leaf rudiment."

What does a cylindrical structure suggest to you?

"A stem."

In other words, we have a stem-like structure before we have a leaf, and if ontogeny repeats phylogeny, what might this suggest? It does not prove it, but what does it suggest?

"That perhaps we had stems before we had leaves."

A note for the artist! "Draw a shoot, but remember, no leaves." "But," he is going to ask, "what kind of stem do you want? one with a single trunk like a palm, or a stem like a pine, or something that branches like an apple tree?" This takes us to that other exclamation point, asterisk, and question mark that stand by the seedling. How does a morning glory seedling get on with the business of forming leaves? The diagrams are on the board, first the horseshoe-shaped leaf and finally the oval, pointed leaf that we associate with the morning glory. You say, "What bearing does this have on stems? These are leaves." If we had stems before we had leaves, what are leaves?

"Modified stems."

If leaves are modified stems and if we read the history of the development of morning glory leaves backwards, we observe that the venation or veining of the leaves is dichotomous in the first leaves, monopodial in the later or foliage leaves. How would this ancient stem have branched? If leaves are modified stems and the venation is dichotomous before it is monopodial, what note would you leave with the artist?

"Make the branching dichotomous."

Of course we don't know how big a stem to draw, and it would be helpful if we knew where to draw it. Where are you going to set this stem into the drawing of the theoretical plant already started? Let us go back to the ontogeny of apple trees. The apple tree came from a seedling, the seedling from an embryo, the embryo from a zygote or fertilized egg. Now where do you find those eggs?

"In female gametangia."

Where then shall we attach this stem?

"It must grow out of the female gametangium."

If this stem is not to rupture the female gametangium, tear the thallus apart, and root itself in the soil, it must be on the small side as size goes. About how big do you suppose the stem would have to be?

"A few inches high."

Well, that is good enough, and if only a few inches high, it could not branch very much.

But there is still another question mark and exclamation point; this time standing by the seed. We are curiously uncritical about seeds: "Seeds are seeds." For once let us ask ourselves the question we have never asked before: "What, really, is a seed?"

"A seed has an embryo inside, a thin layer of endosperm, and a seed coat."

All right, but where does an embryo come from? If we go back far enough, an embryo has its origin in a zygote. What is a zygote?

"A zygote is a fertilized egg."

And where do we find this egg?

"In an embryo sac."

Well, this part of the seed, the embryo, has its origin in an embryo sac. What about the endosperm?

"The endosperm surrounds the embryo now; it must have surrounded the embryo when it was smaller, when it lay in the embryo sac."

The seed coat, we also see, has its origin in the heavy wall of the bell-shaped structure that surrounds the embryo sac. That bell-shaped structure we call an ovule. What is a seed?

"It's an ovule."

Most of you and most of us are content to say that a seed is a modified ovule, but how penetrating an observation is this, how much does it tell us about the historical origin of seeds? Do we mean to say that ancestral apple trees had ovules? No, do it again. If the embryo and the endosperm can be traced to an embryo sac, and if the seed coat can be traced to the wall around the embryo sac, everything turns on our figuring out what an embryo sac is. What is an embryo sac?

"An embryo sac is a germinated megaspore."

If an embryo sac is a germinated megaspore, what is an ovule? What is a seed?

"An ovule must be a sporangium, because it is the 'covering' of a spore."

What is a seed then?

"Since a seed is a modified ovule and an ovule is a sporangium, a seed must be a modified sporangium."

So we write another note, "Draw a sporangium." And what is a sporangium?

"A sac of spores tied to the diploid generations."

You have no way of knowing it, but you are well on your way to not only discovering how an apple tree happened but also to recreating a flora 60 million years old. Piece by piece you are recreating a plant that flourished during the Silurian, a plant that may well have been the first vascular plant in what is now the township of Pullman. What do you suppose a vascular plant is? You have used the word vascular before.

"There was the blood-vascular system in man."

Yes, and vascular rays. What does vascular mean?

"Something that has the nature of vessels or tubes."

Vascular is an adjective, vessel a noun. What is a vascular plant?

"One that has vessels or tubes which conduct fluid."

But do not all plants have to conduct fluids if they are to distribute water, minerals, and food? What are vascular plants?

"Those with tissue specialized for conducting water, minerals, and food."

What are the specialized conducting tissues in a flowering plant like the apple tree?

"Vascular rays."

How much conducting do they do?

"Just in and out."

How about up and down? What are the vascular tissues?

"Xylem and phloem."

What are vascular plants?

"Plants with xylem and phloem."

When the first vascular plant landed on Plymouth

rock, the eastern or western version, and established itself on the shores of an ancient ocean which reached to the foothills of the Rockies, it was a pretty good vascular plant, but it must look to you like an odd assemblage of spores, sporangia, thalli, and gametangia. It had a shoot only two to three inches high, and this shoot lacked leaves and branched dichotomously. How do you suppose we anchored this shoot?

"By roots."

No, it didn't have roots. If this plant lacked roots where do you suppose the roots of modern plants came from?

"Did they have to come from something?"

Everything else has had a history. In terms of the anatomy you know of present-day stems, roots, and leaves, what would you guess might have been the probable origin of roots?

"From stems."

How different are roots and stems?

"Not very different."

If I were to ask you to draw the cross-section of an ancient fossil stem without your ever having seen it, you would consider me unreasonable. But I am not unreasonable. You can do it. If ancient plants lacked leaves, where did photosynthesis occur?

"In the stem."

And if stems, then, were like apple tree stems today, what presumably was the photosynthetic tissue?

"The cortex."

This cortex had to be covered with something. How do you know?

"There are no structural or chemical provisions in cortex to reduce evaporation."

What tissues on an apple tree stem today reduce evaporation or transpiration?

"Epidermis and cork."

What tissue can we deduce formed the outside of these old stems?

"Epidermis."

Good boy, why not cork?

"That which comes first today probably came first historically."

Which comes first today?

"Epidermis."

What theory are you leaning on when you make this choice?

"The theory of recapitulation."

Roots, we have suggested, are probably modified stems, but roots today are more like the original stems than stems are. Why are roots conservative; why have they changed less than stems? You don't know. Well let us go way back and start at the beginning. What caused change in biological organisms?

"Sexual reproduction and mutation."

Would roots experience less change in their genetic constitution than stems if change is due to sexual reproduction?

"Yes."

But they couldn't. How do we know that all the genetics changes brought about in a stem would be shared by the root? Where does sexual change occur?

"In meiosis and karyogamy."

And where does meiosis occur?

"In the formation of gametes."

And where does karyogamy occur?

"In the fusion of gametes."

How do we know that roots, like or unlike stems, have the same genes as stems?

"From the first division of the zygote to the last cell formed in the root or in the stem, the process is cell division."

What does that have to do with it?

"Cell division involves mitosis."

And?

"Mitosis perpetuates the same number and kinds of chromosomes; the same number and kind of genes."

So if stems and roots experience genetic change, they change together. How then can one become morphologically or anatomically different from the other; how can one be more conservative? How can one "change" less?

"Does it involve adaptation?"

It does—it involves natural selection, but how does this work?

"It's like man, or land animals; if you have two different environmental 'niches,' different structures could be established and survive."

But back to the original question! if the root today is more like the stem of yesterday than are today's stems, what tissue would you be sure *not* to find in the center of these ancient stems?

"Pith."

What would you find in its place?

"Xylem."

Do you think these first land plants had xylem?

"A little while back you said they were vascular."

All right. On what other ground could you reason that they must have had xylem?

"These old plants had their feet in the water, but they were putting a shoot up into the air for the first time and probably losing a lot of water from it."

What does *this* have to do with it?

"It would have to move the water faster than osmosis could move it."

Let us complete our plant, drawing in the anatomical detail of the stem, and then let us check our theoretical structure against the actual fossil evidence. Here is a picture of a Silurian landscape, here a detail of a single plant, and here a section of a fossil stem.

"Well, I'll be . . . !"

Editorial—

Pantograph

IN THE CASE of most dreams we are not disturbed, on waking, to know they were not real, and in cases of nightmare we are glad. But our waking dreams we take more seriously. They express our hopes, all that gives meaning to life. And our waking nightmares are our fears. We who teach have dreams and dreads like other men, and we have special ones as teachers.

Just now we have new channels for dreams and dreads.

It is natural enough for us to dream of achievement in our teaching. We think of teachers who stood out as great, and we would be like them. Each of us would like to be a stimulating interpreter of our particular subject, an interpreter also of individual human lives supported and inspired by it. This is an abiding dream of all vital teachers which we wish might be real, though usually we know our performance falls short. We plan a class meeting with enthusiasm and in prospect see the lighted faces of our students with the teacher glowing in his students' light if not his own. But as the class draws to a close, we behold apathy and calm—no fire. We know that what we had hoped was not achieved.

And then come doubt and fear: why are students unresponsive? Can the teacher escape the blame? What lacks in scholarship or manner or talent may be the cause? Is the teaching clumsy and incompetent? It is nightmare for a teacher to doubt the quality of his teaching art.

Do we not, one and all, yearn to have our skills magnified and our faults minimized? Would we not welcome some kind of pedagogical pantograph that would project our teaching, enlarged in scale to extend its strength and somehow reduced in places to minimize its faults?

TV teaching does not meet these specifications but overwhelms them. It appears that it could be the ultimate in wish fulfillment for the gifted teacher, while for many it could mean more than a minimizing of faults: it might mean liquidation altogether. To him that hath gifts may be given a multitude of classrooms, and from him that hath not may be taken away even the classroom that he hath. Let no one doubt that TV is bringing dreams and nightmares alike.

TV teaching is still being tried out. Neither its possibilities nor its limitations can yet be stated. But at a time when the demands that are about to be made on teachers and teaching seem almost alarming, it is fortunate to have a new tool of teaching to utilize for all it may be worth. We need to keep informed about TV teaching, how it works. We need to encourage those engaged in it and cooperate when we can in TV teaching projects.

Experience in TV teaching will enlarge the orbit and enrich the impact of teaching. It will compel appraisal not only of TV teaching but of all teaching. Questions will be asked and some new answers given on what is the nature of teaching and learning and how well TV teaching contributes. What things are there in teaching other than speaking and demonstrating? If TV cannot provide these other elements, how important are they, and how are they to be provided to supplement TV teaching? As such questions are asked and answered, the inquiries cannot fail to benefit teaching.

Perhaps the greatest fear we should have about TV teaching is, not that it might supplant the rank and file of teachers, but that its impact will be less and slower than it ought to be. The appearance of printed books must have seemed a revolutionary factor for university teaching, and yet, even today, how much lecturing still goes on as though books did not exist. We ought to welcome TV teaching for all it is worth, reassured by the realization that teaching cannot be reduced to screen and sound. The interpersonal interchange that is indispensable in teaching and learning will require provisions more human and intimate than any coaxial mechanism now developed or yet to be.

TV for College Instruction

Dr. McKeachie is a psychologist who has active interest in the application of his specialty in college teaching. He has contributed previous articles on several aspects of college and university teaching, is the author of an unpretentious but excellent little book "Teaching Tips," and has received a $1,000 award for distinguished teaching. He now shares with us his study and experience of TV teaching.

By W. J. McKEACHIE

THE FATE OF TELEVISION as an educational medium has been one of the most hotly contested of recent educational affrays. The intensity of this battle is reflected in the strength of proponents' belief in the educational potentiality of television, and of opponents' equally strong belief in its perniciousness.

Four sources of evidence concerning instruction by closed circuit television are presently available. They are:

- Experiments and experiences of colleges, universities, and other educational institutions which have used closed-circuit television for instruction.
- Experiments in closed-circuit instruction by the Armed Forces.
- Experiences in collegiate level instruction on broadcast television.
- Experiments in instruction by film.

Before reviewing this research, let us consider two hypotheses which may help in analyzing the research results: (1) Television is not a method of instruction in the sense that discussion and lecture are methods of instruction. It simply is a means of giving the student a clear view of the instructional situation. Therefore we would expect the relative effectiveness of teaching via television to vary depending upon the importance of being able to see clearly. Thus we would expect television to be effective when it is important for students to *see* demonstrations, visiting lecturers, or films. (2) Television reduces the opportunity for students to communicate to teachers and for teachers to interact with students. We would thus expect the effectiveness of television to vary inversely with the importance of two-way communication.

PENNSYLVANIA STATE UNIVERSITY

In 1954 Pennsylvania State University received a grant from the Fund for the Advancement of Education to study the effectiveness of conventional courses taught for a full semester over closed circuit television using moderate cost equipment as compared with the same instruction given in the usual manner. (6) Using these funds Penn State set up a program of research on courses in General Chemistry, General Psychology, and Psychology of Marriage. In 1957 the research program was continued with the goals of (1) extending the project to additional courses, (2) studying instructional variables, and (3) working on methods of improving instruction on television.

The Pennsylvania State project is probably the most extensive research program in college level television instruction to date. Fortunately the studies are well controlled and thoroughly reported.

The results of this research may be used either to extoll or damn television. Essentially they indicate that there is little loss in student learning in courses taught by television as compared with courses taught conventionally. For example, the first experiment dealt with the lecture portion of courses in General Chemistry and in General Psychology. In the Chemistry course the differences between methods in objective measures of information were not significant. In the General Psychology course the conventional class did prove to be superior in knowledge to the class taking the class via television.

Not only did students learn the information needed to pass examinations, but most did not object strongly to the televised classes.

Students in psychology were asked "How much they liked psychology" and "How much it contributed to their education as compared with other courses they were taking." On both counts ratings of the students in the television classes were lower than those of students who were in the same room as the instructor.

The Psychology students were also asked if they would like to take another course in Psychology. About the same percentages signed up in all 3 types of classes, but when asked if they would prefer taking it in a large class or by television, a plurality preferred television.

These results seem to hold up well for a wide variety of subject-matter areas. Pennsylvania State has now used television for teaching a wide variety of courses. From our hypothesis that television would be of most value in courses depending upon visual presentation of information we might expect it to be more effective in chemistry and electrical engineering than in other courses. From our second hypothesis that television would be of less value in classes where interaction between students and instructor is important we might expect it to be relatively less effective in psychology and speech. However, such comparisons are difficult to make. As we have seen, students learned as much by television as in conventional

* The material for this paper was gathered for a report to Dean Charles Odegaard of the College of Literature, Science, and Arts of the University of Michigan. The advice of Dean Charles Odegaard, Dr. D. G. Marquis, and Dr. Roger Heyns is gratefully acknowledged.

classes in chemistry, but in general psychology the television students did more poorly than other students. This evidence is in line with our assumption, but certainly not conclusive.

The apparent effectiveness of television is particularly astonishing to one who has seen the inattention in many television classes. If students who are obviously inattentive learn as much as those who appear to be attentive, one might doubt the validity of the measures of learning used or would suspect that many students have developed the ability of appearing to be attentive in conventional classes even though their minds are wandering. In the latter case, television students may simply be exposing the reactions to lectures which students ordinarily hide.

Recognizing that instructor-student interaction is sometimes important in learning, Pennsylvania State installed "2-way" microphone communication in the receiving rooms so that students in the receiving rooms could ask questions. They found that this method of instruction was not superior to simple one-way communication. This result is supported by the Army's experience with 2-way communication. (11)

Another attempt to combine the value of interaction with that of television was an experiment in presenting a 35 minute television lesson followed by a discussion period of fifteen minutes in each of the receiving rooms. Other students in the same course observed by means of television the fifteen minute discussion conducted by the instructor with eight students in the origination room. Still other students were allowed to leave or to study their notes. As with the other attempt to provide interaction, results showed no significant differences in test performance between students taught by each of these three methods. A poll of students indicated that they preferred two hours of lecture followed by a full period of discussion to a short discussion each period.

The Pennsylvania State research does provide some support for the idea that television's effectiveness is in giving the student a good view. In one experiment students who had three weeks of instruction by television and five weeks of face-to-face classroom instruction were given their choice of whether to finish the course in television classrooms or in the originating room. Depending upon the course one-third to two-thirds of the students chose television. The most interesting aspect of this finding was that these students were predominantly those who had been assigned seats toward the back of the lecture hall.

The Pennsylvania State group has also worked on a number of other problems. For example, they have found that the size of the viewing group is not an important variable in television instruction. Proctors in the viewing rooms also do not contribute to student learning.

Some theorists suggest that one of the important outcomes of education is that students tend to identify with teachers. Enthusiasts for television have suggested that television would increase student identification with the instructor by helping the student feel closer to the instructor in terms of the student's ability to observe facial expression, eye movements, and other individual characteristics not as clearly observable in a large lecture hall. While this may be true, it is disturbing to find that the television students at Pennsylvania State reportedly do not come in to talk to the instructor outside of class. Whether this would be paralleled by the behavior of students in other classes of the same size is not known. If individual contact with an instructor is important in learning, the large class, whether taught by television or not, may be ineffective.

Case Institute of Technology

It's appropriate that the system of closed-circuit television instruction incorporating the most-highly developed technology is at Case.

Case has 2-way communication between instructor and remote classrooms both visually and audibly. Thus the instructor can address by name any student in the remote classrooms who seems perplexed or inattentive. In fact, the Case system will eventually have remote controlled cameras which will enable the instructor to press a button which will aim the camera at the student who wants to ask a question.

The Case system permits more flexible use of television in instruction. For example, an instructor can take a camera into a laboratory to observe an experiment or piece of equipment and answer the questions of students in the viewing rooms. So far Case's greatest success in television instruction has come in a course in Graphics in which television provides all students with an excellent view of graphic materials.

Iowa

Another attempt to combine the advantages of discussion and television is the Iowa trial of using a panel of 14 students in the studio and 2-way communication with the 2 viewing rooms in each of which 33 other students can view the discussion of the panel and may interpose questions or comments. (15) A third viewing room contains a control group which can see and hear but not participate. Courses in "Comparative Foreign Government," "American Government," and "Greeks and the Bible" have been taught by this method with good student participation both in the studio and in the viewing rooms. It is evident that this type of presentation faces many of the same problems as must be faced in any attempt to conduct a discussion in a class of 80. If participation is important, the larger the number of students the fewer opportunities each student has to participate. However, studies of conferences suggest that actual participation may be less important, as judged by satisfaction, than a group member's feeling of freedom to participate if he wants to. It may be that when students are in groups of 30 in the Iowa experiment, they feel more freedom to participate than if all 80 students were in one room. In any case with good instruction there seems to be a good deal of involvement of students in the viewing room.

Both Iowa and Case use monitors in the viewing rooms and report that the attitude of the monitor has a marked effect on that of his students. An enthusiastic monitor apparently can build group spirit in his viewing room even though his part in instruction is virtually nil. On the other hand if the monitor dislikes TV instruction, students in his viewing room express hostility toward the class. While there have been no empirical studies of this phenomenon, differences in classroom climate seem apparent even to a visitor.

New York University

Another major college program in teaching by closed circuit television is that at New York University, where

courses in English Composition and in Survey of English Composition and in Survey of English Literature have been given by television. (30) The NYU plan differs from Pennsylvania State and Iowa in that the classes are produced in a television studio with a professional producer and an audio-visual materials coordinator. Students meet for two periods in television lecture-demonstration classes, and one period a week in small discussion groups. Experimental results are not yet available.

Miami University

A fourth major project in closed-circuit instruction is that at Miami University. (25) Miami is of interest because the courses being televised include subjects not previously taught via closed-circuit television, such as educational psychology, physiology, sociology, and human biology; because they are comparing closed-circuit television both with large lecture classes and small semi-discussion classes; and because they are studying the possible differential effect of different types of instruction upon students of differing abilities.

Like New York University, Miami attempts to use each method at its best. The television courses utilize professional directors, and audio-visual assistance is available for use both in television and in the other classes. The result is that the television classes do gain and hold student attention as well as most good classroom lectures.

In Miami's first experiment, the primary measures of achievement were final examinations in each course, and the television classes were not inferior on this criterion. In fact in "Human Biology" the television students scored higher than the conventional classes, although there were other factors which might have contributed to this difference. Student ability generally did not make a difference in the relative effectiveness of television, but in English, students of low ability did less well in classes of 56 students than in classes of 28 students.

Student ratings of television instruction are inversely correlated with student ability. While the best television instructors are liked by all types of students, the better students ordinarily dislike television and large classes more than the poorer students. However, attitudes toward television are not correlated with achievement. Students who dislike television do as well as those who like it.

Both in large lectures and in television sections, students complain of lack of contact with the instructor, but in general, Miami students dislike television less than large lectures, although their attitudes toward television tended to become more negative as the semester wore on. (It should be noted that Miami has a tradition of small classes.) If they could have the same instructor, Miami students would generally prefer a small section to television or a large class, but they would prefer television or a large class to the small class if they could be sure of an excellent instructor in the television or large class and had to take their chances in electing a small class. This is probably a pretty realistic alternative.

Stephens College

At least one research project in the use of closed-circuit television has resulted not in reducing the number of teachers needed for a given number of students but rather in adding to the need for additional staff. Stephens College (35) has used television as a means of providing a stimulus for discussion. Briefly, the Stephens plan is to bring to Stephens each semester an outstanding visiting teacher who delivers a twenty minute lecture twice a week. This lecture is carried by television to fifty classrooms in each of which fifteen to twenty students are gathered with a member of the Stephens faculty. As soon as the television presentation is completed, discussions begin in each of the classrooms.

While the results of this experiment will not be complete until later, the plan embodies some very interesting ideas, for in planning this course the Stephens faculty was thinking of education as extending beyond the classroom. They felt that by providing this common educational experience for all freshmen (and by craftily scheduling it for the period just before lunch) students would continue their discussions in the dining halls and dormitories. The students report that this actually did take place.

The Stephens experience is unique in another respect. While all of the other television projects have failed to achieve complete faculty acceptance, the Stephens faculty seems to be interested in, and even enthusiastic about, the course. Not only does the course provide a common topic for discussion by the students, it also provides a common intellectual experience for the faculty. With a large part of the faculty involved in leading discussion groups and many of the others watching the television presentations, faculty members as well as students have common experiences and problems which they can discuss with members of other departments. Furthermore, in their own teaching, faculty members can refer to points raised in the television presentations, knowing that this at least is common to the background of the students.

Armed Forces Research

Like the colleges the Armed Forces have found that many of their courses can be taught by television without loss in measured learning. In some cases television instruction has proved to be superior to regular instruction.

If one can achieve satisfactory results by having one good teacher teach several classes at the same time via television, would it not be more economical to kinescope the lessons so that this instruction could be made available to an infinite number of classrooms?

It is not surprising that the Armed Forces have tried to answer this question by research. In some experiments, kinescopes have been as effective as live television. Moreover when kinescopes were used for review of the lessons, greater learning took place. However, Army researchers have shown that the effectiveness of kinescope instruction may be adversely affected by technically poor kinescopes, with the loss being greatest on visual content such as recognition training. (21)

One early study found that if students thought a film was a kinescope, they learned more. Fortunately this experiment was repeated in 1955, and no differences were found. (17) This suggests that experiments conducted in situations in which television instruction is something new and glamorous may not be good indications of the results of television instruction after television is taken for granted.

Since kinescopes can be used to train large numbers of men, it becomes practical to spend a great deal of time

and money in making each lesson as nearly perfect as possible. One of the things which the Signal Corps discovered in attempting to analyze the teaching of excellent instructors was that much class time was apparently wasted. Thus an hour's lecture was reduced to a half-hour kinescope. Their results show no loss of learning when the two presentations are compared. (32) Earlier instructional film research at Pennsylvania State indicated that effective instruction requires some "low spots"; so there may be limits to the effectiveness of condensation. However, there seems to be a good deal of agreement that the ideal television pace is more rapid than that of a good lecture.

The Army has used television in teaching a number of different subjects. Lessons in which television was especially effective were those involving manipulation or functioning of small equipment (e.g., machine gun assembly) and map reading. (21) This fits with our hypothesis that television would be most effective when perception of small details is important.

If one accepts the idea of multiplying the effectiveness of the "master teacher" by television, one of the first problems is "Who is the master teacher?" This problem may be complicated by adding the question, "Is the master teacher also the master television teacher?"

Although these questions remain unanswered, the Armed Forces did find in one experiment (21) that teachers differed in television effectiveness and that some teachers were better on television than in the classroom, while others were more effective in the classroom than on television.

One would suspect that instructors differ in the degree to which they respond to cues from students. Loss of these cues would thus affect teachers differently. In addition, instructors probably differ in the degree to which they communicate by expressive movements of the face and body. Someone whose face is very expressive might be more effective on television than in a large classroom.

The Armed Forces have recently been trying methods of training television instructors. (32) They report that with the use of a cueing device even a person who has never taught before can learn to teach as effectively as experienced television instructors after only *two hours of rehearsal.*

Army research has also studied the effectiveness of television for students of differing levels of ability. While television is about as effective as live instruction for most levels of ability, it is *more effective* than live instruction for the less intelligent Army trainee. (21) There seems to be no good theoretical explanation for this finding.

Broadcast Television

Although broadcast television has been much ahead of closed-circuit television in the number of courses offered and the number of institutions involved, relatively little research on broadcast television is relevant to the problems discussed in this paper. A number of studies (e.g., 10, 18) have shown that students taking a course at home by television do as well as those taking it in person (which may suggest connecting closed circuit television to the dormitories as well as to classrooms).

One of the most interesting experiments in this area was carried out by the Canadian Broadcasting Corporation and the University of Toronto. This experiment compared television, radio, reading, and studio presentation of a single lecture on anthropology to University of Toronto students. (41) In this well-controlled experiment, television was significantly superior to the other media, and particularly so for the brighter students. Furthermore, television's superiority was maintained on a test of retention eight months later. (29)

One should note, however, that this television lesson was apparently a highlight of the course for these students. It is possible that the results can be generalized only to situations in which students are taken to a television station to view one of their lessons which is being presented to a nationwide audience.

Research on Instructional Films

Many of the problems of educational television are similar to those of educational films, and the research on educational films thus provides some useful generalizations for educational television. For example, instructional film research clearly showed that students learn to learn from films, i.e., students with previous experience in viewing instructional films learn more than those without such experience. (39) Experience may also be an important consideration in comparisons of television with other methods. It thus is quite likely that the student must also learn to learn from television, and one would suspect that habits of leisure time viewing do not contribute to such learning. However, it should be pointed out that in the Pennsylvania State television experiments there was no significant gain in television effectiveness as compared with conventional teaching during the semester even though periodic measures were obtained.

Other research on films is also relevant to particular potential uses of television. In one experiment (40), in which the effectiveness of teaching ninth grade general science classes by (a) film, (b) film plus study guides, and (c) lecture was studied, the film plus study guide method proved superior both to "film alone" and lecture methods. The superiority of this method was demonstrated both on tests of knowledge at the end of the course and a retest three months later. Since films alone were not superior and if anything slightly inferior to lecture, the study guide seems to be the most important variable in this experiment, suggesting that the media of instruction are less important than the method of instruction.

Another hint for the television instructor and for the classroom lecturer is that audience participation devices in films increase learning (at least of rote learning material). This advantage is particularly great for difficult material and for the poorer students.

Summary and Conclusions

▶ The Pennsylvania State and Army experiments demonstrate that television is about as effective as the classroom lecture in communicating information, changing attitudes, and arousing interest in a subject.

Since research indicates that much of the material taught by the lecture method can be as effectively communicated in written form, one might consider the possible economy of repro-

duction of lecture materials as another alternative to television. Parsons showed that an education course can be as effectively taught by correspondence as by kinescope or in person. (28)

When a course demands the demonstration of small objects or parts, television should be advantageous and there seems to be general agreement that it is a useful aid in such courses. Whether to use television or film would seem to be largely a matter of the relative cost. Again there seems to be a tendency to forget the possibility of reproduction of diagrams and photographs as an alternative to television. While television and film would seem to be clearly advantageous as methods of presenting relations between moving parts, many of the "visuals" used on television do not necessarily involve movement, and many photographs, enlargements, slides, and lithoprints can be made for the price of one television camera.

Insofar as student-instructor interaction is necessary for teaching a course, television would appear to be of little help. Television does not permit more students to talk even with two-way audio-connections. It is apparent that the student's opportunity to participate is an inverse function of the number of students in the class. If actual participation is important, larger classes should be less effective whether they are taught in one classroom or by television. However, television does permit students to gather in smaller groups (as at Iowa) and this may help develop a sense of participation. The Stephens experiment and the ninety-minute classes at Miami use television to provide the stimulus for discussion, and this seems to be successful.

▶ Whether or not certain students learn more effectively by television while others learn more effectively in the classroom is a problem which merits additional research. In the Army experiments there was clear evidence that the less intelligent students benefited most from television instruction, but the Miami experiment suggests that the poorer students may be those most in need of individual correction in some courses.

▶ While research has demonstrated that instructors differ in television effectiveness, it has not provided guides for their selection. Most writers agree that the television instructor should *want* to teach on television, be enthusiastic about his course, and free of distracting mannerisms. Such lists of qualifications do not seem to be different from similar descriptions of good college instructors in general. Research in this problem area would contribute to the entire field of higher education.

▶ As we have seen, there seem to be no clearly demonstrated essentials for effective television instruction except a fairly clear picture. If we accept present research results, (1) kinescope is almost as effective as live television (and can be used more flexibly), (2) two-way communication does not add to learning, and (3) size of viewing group is not an important variable. This is another area where more research is needed.

▶ Even if closed-circuit television were a potential answer to all our educational problems, its success would probably depend to some extent on faculty acceptance. Apparently, all of the colleges using closed-circuit television have found that many faculty members are, to say the least, skeptical of its value. Polls generally indicate faculty willingness to teach by television if necessary, but faculty preference is for traditional teaching methods.

Faculty acceptance of television seems to be greatest when the faculty has participated in planning for it. For example, the faculty of Stephens College seems to have accepted television more fully than the faculties of any of the other institutions, and this is probably due in no small part to their involvement in the planning for their television course.

A second factor in the acceptance of television at Stephens is that the course offered does not set a particular department or instructor apart from the rest of the faculty. The course offered at Stephens is interdivisional, involves almost all of the faculty in leading the discussion sections, and is presented by a visiting lecturer. Furthermore, since the course is a new one, no local professor was pushed aside to make room for the visitor.

When television enables a department to provide instruction which would otherwise be difficult or impossible, acceptance also seems to be good. Thus Pennsylvania State found no faculty objection to teaching electrical engineering by television when a large enrollment plus

a staff shortage resulted in several unstaffed sections.

Finally, the support of administrative officials is also of obvious importance. Since television teaching is difficult and time consuming, faculty members are much more likely to participate if they feel that this activity is valued not only by their colleagues but also by their administrative officials. (One evidence of such support is a reduction in teaching load for television instructors.)

Potential Applications

Since relatively few classes require much observation of small moving parts, the need for television does not seem acute. However, there are undoubtedly many courses which could on occasion make effective use of television, and it is probable that most courses taught by lecture and demonstration could be taught over television with little loss in student learning.

Kinescopes might be an effective method of carrying instruction where a college cannot afford to carry instructors. For example, if it becomes difficult to meet the needs for extension teaching, it might be possible to kinescope some of the courses most in demand and send kinescopes when or where a school cannot send an instructor.

Kinescope also provides a means of bringing guest experts into many classrooms. A kinescope of a distinguished visitor might be valuable for teaching for many semesters.

The major asset of educational television is that instructors take it seriously (at least while it's new) and work hard to improve their teaching. Many of the demonstrations and visual aids used by television instructors could have been used by the instructors in their ordinary classrooms, but weren't. One of the best things about television is that it has directed attention toward teaching and evaluation of teaching. Even if television teaching is not expanded, the growing corps of television teachers have probably improved in their teaching both on and off the screen.

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Teaching Educational Psychology by TV

"My recent experience with closed-circuit television instruction has greatly intensified my interest in the evaluation and improvement of teaching effectiveness." So says the author (B.A., M.A., Ph.D., Chicago) who here shares with us his experience and thinking. He has been consultant and director of testing for the Quincy Youth Development Commission, a faculty member at Miami University, contributor to journals, and is now assistant professor at Purdue University.

By JAMES V. MITCHELL, JR.

More and more educational institutions have acquired television installations, and it is probable that it will become increasingly common for college instructors to be requested or to volunteer to accept the challenges of televised teaching. It would seem important that those just embarking on this new adventure should profit from the experiences of others. Those reports that have been published often lack the curricular details or subjective insights that would add meaning to the objective data and thus give the newcomer to televised teaching a better understanding of the fundamental requirements and advantages and disadvantages of this new medium. The present report is an effort on the part of this author to share his television teaching experiences with other college instructors.

The author has taught educational psychology by closed-circuit television as a part of a research project designed to evaluate the effectiveness of large group instruction (5, 6).[1] For three semesters this course was taught over closed-circuit television. During each of these semesters the author also taught exactly the same course in the conventional manner to one or two "control" sections of 30-40 students. Thus an opportunity was afforded to make both objective and subjective comparisons of the relative merits of the two methods of instruction. In the following paragraphs an attempt will be made to describe the lessons learned from this experience.

In the very beginning the author tried to develop a rationale for TV teaching that would guide him in the selection and presentation of course material. The simple transfer of conventional classroom procedures to the television setting seemed likely to be unproductive in two respects: first, it would possibly lead to a loss of instructional effectiveness; and second, it would result in a general bypassing of some of the unique potentialities of television as an instructional medium. The most intelligent approach to this problem seemed to be that of acknowledging frankly the deficiencies of television, ameliorating the effects of such deficiencies whenever possible, and compensating for the deficiencies still remaining by an all-out effort to capitalize on the advantages of the medium. This philosophy was a helpful guide in all phases of television work, and it resulted in the following generalizations regarding the relative advantages and disadvantages of television as an educational medium.

Disadvantages

▶ The most notable deficiency of televised instruction, of course, is the lack of student-teacher contact. This is a problem with a number of psychological corollaries. One of the most important and persistent of these is the fact that students are unable to ask questions during the television presentation. This is a more distressing problem to some students than to others, but with some of the more difficult material it can become a critical issue for all. Attempts to solve this problem with some kind of intercommunication system are likely to be unsuccessful, in the author's opinion, since the mere mechanics of addressing a question are formidable enough to frighten the bravest freshman. But the ill effects of the situation can be avoided somewhat by taking some simple precautions. The first of these is the recognition that a well-prepared and well-organized presentation is even more important for television than for the conventional classroom, since a far greater proportion of questions than we would care to admit probably arise as a result of poor organization in the first place. Careful and exact preparation is a fundamental requirement for television instruction, and such preparation should not only involve adequate organization, but should also involve the repetition of important points more often than customary, and the anticipation of questions that would probably arise regardless of how the subject-matter was taught. These simple precautions will help to reduce questions based upon gross misconceptions, but they will not eliminate the need for class discussion altogether. It is doubtlessly questionable academic practice to present a course on television without providing some opportunity for discussion, and in the author's case this was accomplished by allotting a certain amount of time for small-group discussions led by qualified graduate assistants.

▶ Another corollary of this lack of student-teacher contact is also related to the lack of psychological "feedback" that is characteristic of televised instruction. This is the problem of "pacing" one's presentation in the absence of the usual cues to determine whether the pace adopted is too fast or too slow for most students. This requires the instructor to assume a dual role as self-conscious "listener" and teacher at the same time and to become more aware of his impact and probable reception by his students than he ever has been before. It is a kind of academic empathy that will help to compensate for the lack of direct feedback. But like most kinds of empathy, it needs a little help, and by far the best type of help is that rendered by a perceptive graduate assistant or proctor who has observed the presentation

[1] The project was conducted at Miami University in Oxford, Ohio, under the auspices of the Experimental Study in Instructional Procedures. The author is indebted to Dr. F. G. Macomber, Director, and Dr. Laurence Siegel, Assistant Director, for evaluation data presented in this report. Further information about the evaluation instruments and design of the study may be found in the fifth and sixth references listed at the end of this report.

and the class reaction to it and can comment not only on the appropriateness of the pace but also on the crucial factors of attention and motivation. Such comments should be sought after every television presentation.

A suggested solution to this problem of lack of feedback is to invite a few students into the studio to observe the presentation and ask any questions they may have. This procedure probably creates more problems that it solves, since a typical finding is that many instructors become so absorbed in teaching the few students at hand that those in the viewing rooms tend to be neglected or ignored. The presence of these students in the studio is, in the great majority of cases, more of a distraction than a help.

▶ Still another corollary of this lack of student-teacher contact is the contention of a few students that they lack a feeling of personal relatedness to the course and the instructor because of the interposition of television. Again the author accepted this as a legitimate concern, since he himself had missed the social interaction and academic give-and-take characteristic of the conventional classroom but noticeably absent in the television studio. However, this ill effect can be minimized somewhat by taking the following kinds of positive action: (a) observing and participating in the small-group discussions; (b) inviting students to participate in TV demonstrations whenever possible; (c) making oneself "available" at certain crucial times (e.g., examination time) when students might wish to talk with the instructor; and (d) providing opportunity and encouragement for students to come in individually and talk with the instructor during office hours. Not to be denied, either, is the crucial role that small-group discussion leaders must take in compensating for the lack of a personal relationship between student and instructor, and often the discussion leader must be encouraged to assume this role or be given instruction in *how* to assume it. But although all of these things are important, they are only secondary considerations when viewed in the light of the primary responsibility of the instructor to conduct himself in front of the television cameras in such a way that students will tend to feel a personal relatedness to instructor and course even without the physical presence of the instructor. Whether this is repugnant to our academic sensitivities or not, it seems evident that the television instructor must make an active effort to project his personality out into the TV viewing rooms much more than he was ever required to do in the conventional classroom. To deny this fundamental requirement of television is to render oneself insipid in the viewing rooms.

▶ Another TV problem that seems to be closely related to the lack of student-teacher contact is the tendency for some students to develop greater anxiety about what is expected of them than is typical of these same students in the conventional classroom. After all, educational television is for them a very unstructured situation, and a lack of certainty about course requirements plus the absence of the instructor may provoke anxiety which will quickly turn into frustration and discouragement if positive steps are not taken. The author has found it very advisable to structure a television course considerably more than one would structure the same course taught conventionally, in order to prevent the development of such anxiety.

▶ Another problem that might well be considered by the beginning TV instructor is that of avoiding televised monotony. Just as most teaching personalities tend to lose some of their color on the viewing screen if they adhere strictly to the classroom manner appropriate to the conventional classroom, so do many presentations lose their flavor if transferred bodily to the TV studio. Fifty minutes of lecture, with the same face against the same background, proves even more deadly on the TV screen than in the conventional classroom. Psychological "change of pace" is another fundamental requirement of televised instruction. Demonstrations, interviews, and audio-visual materials should all be inserted into the presentation whenever these are appropriate—and this is often—and used to apply, exemplify, and reinforce the material presented by the instructor. It is also suggested that all the chairs in the studio be equipped with heating elements that cause them to become unbearably hot after ten minutes of sitting, forcing the instructor to relocate in a new place with a new background!

▶ The new TV instructor would also be wise to consider certain limitations in the use of the blackboard on TV. The blackboard or large paper tablet can and should be used on TV, but it must always be kept in mind that anything put on the blackboard, although seemingly large and clearly apparent to the instructor, may become minute and often unintelligible when reduced to twenty-one inch screen size viewed from a twenty foot distance. Long and lengthy written definitions are not appropriate to TV. Large, bold abbreviations, symbols, or schemata work well on TV, and the experienced instructor can guard against illegible blackboard work by careful planning outside the studio and by making use of the monitor screen and the close-up lens occasionally while in the studio. With all audio-visual materials, investment of some time in trying out the materials before the presentation itself usually reaps large rewards. And consultation with TV personnel about the feasibility and usefulness of certain audio-visual materials may avoid later headaches and embarrassment.

Advantages

▶ Contrary to some popular opinion, there are also some decided advantages to televised instruction, and the alert instructor will study these carefully and capitalize on them as often as he can. It has already been mentioned that television courses necessitate a rigorous preparation and organization of materials that far surpass what is typically found. Most newcomers to TV accept this challenge and improve their preparation and organization accordingly. This in itself is an important, though indirect, benefit of television.

▶ Another significant benefit of educational television is that it makes possible a much more elaborate kind of programming than is practicable in the typical classroom setting. Panel discussions and interviews involving guests with specialized talents cannot be repeated on six or seven different occasions for six or seven different classes, but when the same number of students can be reached at the same time through the medium of television, such events not only become feasible but also eminently desirable as a means of exemplifying principles, making learning more meaningful, or increasing motivation. Similarly, a presentation involving the use of several different types of audio-visual materials during the same session can be a very difficult and unwieldy undertaking in the conventional classroom, but in the television studio, with the director and other studio personnel present and ready to assist, the same presentation can become a meaningful and skillfully integrated learning experience that carries great intellectual and psychological impact. This latter consideration is an extremely important one for the present author.

▶ Televised teaching, moreover, can challenge an instructor's creativity even more than the conventional classroom. It is under these conditions—when an instructor is willing to accept televised teaching as a challenge to his creative powers—that televised teaching works out best. Unwillingness to try out new ideas and a generalized rigidity in the face of TV's unique demands spell doom for the instructor, and such an instructor might better avoid TV altogether.

▶ The instructor who is willing to accept TV teaching as a challenge to his creativity will find an important ally in audio-visual techniques. The author found that short excerpts from films would often fit neatly into a lecture presentation and provide just enough exemplification to make a point without belaboring it. Many such film excerpts can be included in the same presentation, and the instructor can relegate to studio or audio-visual personnel the responsibility of changing reels or splicing footage. If an opportunity exists for making one's own films, as it did with the author, even more creative opportunities are open to the instructor. Interviews and discussions with children provide fascinating insights into behavior at the various levels of development, and demonstrations of learning or problem-solving situations, either live or on film, are valuable additions to any presentation. In spite of the fact that the TV instructor will probably make greater use of audio-visual aids than he did in the conventional classroom, he is also likely to find that he can actually cover more material on television than he can in the conventional classroom. All these are decided benefits of televised instruction that ought to be considered when evaluating the final balance sheet between televised and conventional instruction.

Organization of the Course

A close look at the organization of the author's televised course in educational psychology will reveal how the principles described were applied to a two semester sequence that combined the traditional content of general and educational psychology into six units of work, thus avoiding the overlap and repetition often existing between these two courses and permitting the investment of larger blocks of time in intensive study of a given subject-matter area. The author found that one could emphasize the application of psychological principles to the educational setting and yet not overlook or neglect the values generally associated with the study of general psychology, and he would recommend this organization to anyone who is genuinely concerned with a meaningful and integrated preparation in psychology for prospective

teachers. Each of the six units had a unit problem which was intended to focus the student's attention on the nature of the problem-solving task that lay before him, and each class session had a more specific question that could be answered in terms of a thoughtful interpretation of the readings assigned for that session or the TV presentation itself. The six units of the course were as follows:

1 Theory, Method, and Practice in Modern Psychology
2 The Physiological Bases of Behavior
3 Human Growth and Development
4 Educational and Psychological Measurement
5 The Learning Process
6 Personality and Adjustment

It is difficult if not impossible to give a reasonably accurate description of a TV course such as this without providing some examples of actual TV presentations. The following examples[2] will serve to illustrate the type of presentation that was especially well adapted to the TV setting:

UNIT 1

(a) The discussion of methods of investigation in psychology provided an excellent opportunity to explain the experimental design of the research project of which this course was a part. An informal interview was conducted with the evaluation analyst of the project, and he served the twofold function of clarifying the nature of the project and exemplifying some of the methods used by the psychologist in his study of human behavior.

UNIT 2

(a) As a part of this unit on the "Physiological Bases of Behavior" a film on the birth process was shown to the students. Afterwards the students were directed to write down any questions they had about the film, and these questions were collected and sent to the studio by runner. The author then addressed these questions to an obstetrician who had consented to act as a consultant for the session. Note that this procedure of transmitting written questions to the studio, which was used successfully on many different occasions, helps to improve the communication between student and teacher that is otherwise often lacking in televised instruction.
(b) The role of the endocrine system was made more meaningful to students by an interview with a diabetic, who discussed some of the problems of young diabetics, and an interview with a former school nurse, who discussed cases of endocrine disorders in school-age children.
(c) A film demonstrating the electroencephalograph was made to provide concrete evidence of the neurological concomitants of brain function for both normal individuals and those with convulsive disorders.
(d) After a thorough discussion of the physiological bases of hearing, the author conducted an interview with a speech and hearing specialist, who considered the effect of hearing difficulties on school adjustment and ended with a demonstration of the use of the audiometer in the school setting.

UNIT 3

(a) The TV audience was most enthusiastic about the pattern developed for the presentation of the characteristics of development at the various age levels. In each case a group of children representing the age group in question was brought in for an interview or discussion whose primary purpose was to help reveal the developmental characteristics of that age level. Following this the author would make certain generalizations about the developmental characteristics of the age group, using the children's reactions to exemplify as many of these generalizations as possible. It was often surprising how neatly the children's reactions would dovetail with the oral presentation.
(b) During the discussion of the handicapped child a film was presented that depicted a program for blind children that had been inaugurated in a local school system. An interview was conducted with a teacher in the program, and afterwards many students again took advantage of the opportunity to address questions to the visitor.

UNIT 4

(a) In describing the kinds of test instruments available for the evaluation of human performance, the author used students from the viewing rooms to demonstrate some of the tests.
(b) The discussion of intelligence tests included a demonstration of an elementary school child taking selected parts of an individual intelligence test. The close-up lens of the television camera permitted a clear and detailed picture of what the child was doing as he worked with the performance tests. (Needless to say, extreme care was taken to avoid fear or embarrassment to the child or any other effect that would be detrimental to the child's best interests.)

UNIT 5

(a) Demonstrations of the principles of perceptual organization were found to be equally effective over television and often easier to present.
(b) The discussion of *concepts* afforded many opportunities for the active participation of students in demonstrations of the concept-formation process. Students were also shown the author's film of a fifth grade boy working with concept-formation blocks.
(c) For a discussion of problem-solving processes the author had prepared a film showing a subject trying to solve one of the classic "insight" problems (Maier's "two cord" problem). Viewers were also given the opportunity to analyze their own problem-solving processes as they attempted to solve problems presented by the instructor.
(d) When programs for the exceptional child were being considered, another of the author's films was presented, a film portraying a typical day in a classroom for slow learners and a classroom for severely retarded children. After the film the author interviewed a teacher of a slow-learning class, a teacher of a severely retarded group, and the mother of a retarded child.

UNIT 6

(a) To demonstrate the various defense mechanisms, student volunteers acted out short skits exemplifying how each mechanism might operate in a realistic situation. Students in the viewing rooms tried to determine which mechanism was being portrayed, and the author, after identifying the mechanism, would discuss it and give additional examples.
(b) One session involved demonstrations of role-playing and play therapy. A short film had been made showing a little girl in a play therapy situation, and this was shown after a discussion of play therapy. Role-playing was demonstrated by setting up a realistic situation in which a few students from the viewing rooms undertook a completely unrehearsed role-playing assignment after receiving directions from the author.
(c) When methods of assessing personal-social adjustment were being considered, students were given the opportunity of actually taking a sentence completion test and a personality inventory, and of analyzing a sociogram and a "Guess-Who" test based on actual classroom data.

A few brief comments on other aspects of the course may also be in order. The six sections of the course, each comprising 30 students under the guidance of a graduate assistant, met twice a week for an hour and a half. Typically the TV presentation took about an hour, and after a short break the students reassembled to participate in a discussion led by the graduate assistant. However, the ninety minute class period permitted great flexibility of approach, and the typical pattern was departed from whenever appropriate or necessary. The graduate assistants met with the instructor once a week and were always well informed about the program for the week and well prepared for the discussions they were to lead. Written assignments were recorded on the unit guide sheets for each of the questions considered, and students read not only from the required

[2] There is some danger that in describing the "highlights" of a course, the real nature of the course will be distorted, but the author hopes that the reader will realize that these relatively dramatic events in the course were accompanied by a solid grounding in the interpretation and application of important psychological principles.

texts in educational and general psychology, but also from books of readings, government pamphlets, books on child development, and other outside sources. The instructor played a role on two different "teams": the team of graduate assistants responsible for the discussions and the observation of student reaction, and the studio team that helped him with the TV presentation. The latter role required close cooperation with the studio director, who had to know what audio-visual materials were to be presented, and when they were to be shown during the presentation. Before each presentation the instructor conferred with the director and then took some time to "warm up" and refamiliarize himself with the material to be presented.

Student Reaction and Achievement

How did the students react to such a program, and how much did they learn in comparison with students who were taught in the conventional manner? These are important questions that deserve our earnest consideration. Fortunately, we have some excellent data bearing on both these questions, although final answers must await the collection and analysis of even more data from studies of this kind. While the author was teaching the televised course, he was also teaching the same course to a conventional class of 37 students. The conventional class was given the same content, but an effort was made to capitalize on the advantages of the small group organization by employing a discussion approach whenever possible. The following comparisons of the "experimental" group (TV; $N = 167$) and "control" group (conventional; $N = 37$) are all based on objective data secured by the evaluation analyst for the first and second semesters of the 1956-57 academic year.

Student opinion of the teaching proficiency of the instructor was remarkably similar for both TV and control groups. At the end of the first semester a "Rating Scale for College Teachers" was administered to both groups. This scale is a Thurstone-type attitude scale that requires students to rate their instructor on each of twenty-four items relating to teaching effectiveness, and scores below 5.0 are favorable (i.e., the instructor is better than average), while scores above 5.0 are unfavorable. In both the TV and control groups the instructor was given exactly the same rating: 2.28. Furthermore, when individual items in the scale were analyzed, there were similarly small differences between TV and control groups. For both groups, at least 85% of the students reported that the instructor gave well organized lectures, made major points clear, was enthusiastic about his teaching, and held the interest of the class; and there were no significant differences between the two groups for any of these items. It is interesting to note, however, that a significant difference did appear for the item: "Instructor paces lecture properly in speed and content to students' comprehension." Here 92% of the control group agreed with the statement, while only 75% of the TV group agreed, a difference significant at the 1% level. This difference provides additional evidence of one of the unfortunate effects of the lack of student-teacher contact in televised instruction, and it should challenge the TV instructor to do some serious thinking about methods of improving feedback in televised instruction.

Although student opinion of the instructor was the same for both TV and control groups, the two groups did appraise the *course* differently. At the end of the first semester both groups were administered a rating scale on "Attitude toward Course Content." Like the rating scale for instructors, this scale is a nine point scale in which a score of 5.0 is the neutral point, and scores below 5.0 are favorable (i.e., the course is above average), and scores above 5.0 are unfavorable. On this scale the average ratings of the course for the TV and control groups were 2.87 and 3.20, respectively, a difference which is significant at the 5% level. The students in the televised course apparently liked the course somewhat more than those in the conventional class, even though

Table 1
Percent in TV and Control Groups Agreeing with Selected Items in the Course-Rating Scale

Item	Percent agreeing		t	p
	TV	Control		
I was stimulated to do the class assignments prior to each class meeting.	84	59	3.44	.001
I frequently found myself wanting to discuss what I had learned in class with friends.	92	78	2.46	.05
This course has stimulated me to think.	92	70	3.73	.001
This class is responsible for making me consider a vocation in this subject area.	37	11	3.07	.01

instructor ratings were the same for both groups. To determine why this is so one has to think in terms of the differences between these two groups. There were two fundamental differences: (a) the control group was taught by the discussion method when possible; and (b) the control group did not participate in some of the special programs (e.g., interviews and some demonstrations) that were unadaptable and impractical in the conventional setting. Since the first difference did not furnish any reason for the TV group's higher rating of the course, that higher rating must be attributed to the psychological impact of some of the special programs that were presented to the TV group. The greater impact of the TV course is revealed even more clearly in Table 1, in which responses to certain individual items in the course-rating scale are analyzed. Especially noteworthy here is the fact that the greater popularity of the TV course did not result merely from pleasurable feelings accompanying the passive assimilation of course material, but was related to the learner's desire to become actively enmeshed in the interpretation and application of the principles that were taught. This finding is particularly important when viewed in the light of the oft-repeated statement that televised instruction will *necessarily* lead to greater passivity in learning.

Additional data should be considered, however, before a final judgment is made. All objective data presented so far have been based on student reaction at the end of the first semester. Unfortunately, data comparable to that described were not collected at the end of the second semester, but there were other types of data collected at the end of both the first and second semester that furnish some interesting food for thought. Some important data, for instance, came from a rating scale on "Attitude toward Televised Classes," which required students to evaluate the effectiveness of televised instruction in comparison with conventional instruction. On this scale scores below 5.0 favor TV instruction, while scores above 5.0 favor conventional instruction. The TV group had an average score of 4.29 at the end of the first semester and 4.78 at the end of the second semester. This shift toward a somewhat less favorable attitude toward televised instruction at the end of the second semester is even more evident in student response to the following item on the scale:

> *"You may have the option next semester of enrolling in either a TV section or a conventional section of a particular course. If both sections are taught by the same instructor (whom you like) and are given at desirable hours which fit in with your schedule, which will you choose?*
> *A. The TV section*
> *B. The conventional section"*

At the end of the first semester 79% of the TV group actually favored the TV section over the conventional section, but by the end of the second semester this figure had dropped to 48%. In this same scale students were also given three multiple choice questions that required them to compare TV and conventional instruction with respect to the amount learned, the attention-holding power of the class, and the extent of their preparation for the class. (Once again the higher scores were those less favorable toward TV, with 5.0 as the neutral point.) The results were as follows:

"Learning"—First Semester, 3.38;
Second Semester, 4.30

"Attention"—First Semester, 3.66;
Second Semester, 4.18

"Preparation"—First Semester, 4.90;
Second Semester, 5.41

All these differences were significant at the 5% level, and the difference for "Attention" was significant at the 1% level. All this is incontrovertible evidence that students reacted less favorably toward TV instruction at the end of the second semester than at the end of the first. Some explanation is called for here, and the author submits that these less favorable attitudes at the end of the year resulted from two principal conditions: (a) At the end of the first semester the students were very fascinated by the interviews which were conducted with children as a part of Unit III, while in the second semester the course covered more mundane topics such as learning and evaluation, and the instructor even had the gall to require his students to take quite a few personality tests in order to obtain some research data, and these were given at the very end of the semester. (b) It is this author's impression that regardless of the content of the course, a progressive disenchantment with televised instruction will generally occur with time. It is also the author's belief that this progressive disenchantment and consequent loss of motivation will affect achievement. This was certainly true for the present course, since average scores on the final examination for the first semester were 113.98 and 116.88 for the TV and control groups respectively, which was not a

significant difference, while the corresponding scores on the final for the second semester were 145.10 and 153.56 for the TV and control groups respectively, and this difference was significant at the 5% level.[3] This, too, is a matter that must be taken seriously in the final evaluation of the balance sheet between TV and conventional instruction.

Discussion

What are we to conclude, then, about the value of TV instruction? The author would prefer to take the point of view that the data have been presented and the reader is now free to make his own judgment about the issue. But the author also finds it hard to resist the desire to make a few observations. It is evident that televised instruction has both advantages and disadvantages, and it is equally evident that educational psychology lends itself very well to televised instruction. But in all probability most academic people will feel that the disadvantages of TV outweigh the advantages, especially when the possibility of student disenchantment and lowered achievement is considered (and when we also consider the effects of a cumulative disenchantment that might arise if a student's entire course-load were taken by television!). It is also doubtlessly true that the instructor who elects to work against these disadvantages of TV will not only have to be creative, but also well-nigh indefatigable, since good TV instruction takes a great deal of time, and this great expenditure of time will probably require specialization in one course to the exclusion of some other courses and even some other academic interests. But what are the alternatives, if those of us in the academic profession accept the responsibility of educating the great numbers of young people who will want a college education in the years ahead? Even with more stringent entrance requirements, there will still be the basic problem of educating large numbers of students with relatively few well-qualified instructors available. Possible solutions to this problem seem few in number and usually somewhat lacking in comparison with the benefits of small group instruction. These would include televised instruction, large lecture-group organization, or the use of many less qualified graduate assistants under the supervision of a well-prepared and experienced instructor. Each of these has its own peculiar advantages and disadvantages, and the present author would contend that only by combining all three of these approaches can large-group instruction approximate or perhaps equal the effectiveness of small class instruction. With such a combination the instructor could decide whether his material for a given session could be most effectively presented over television or in lecture before a large group, and he could vary these methods sufficiently to avoid boredom or disenchantment with either. The values of small group discussion would be retained through the regular scheduling of discussion sections led by qualified graduate assistants. Each of the three approaches could be utilized in terms of a considered judgment of its unique contribution to the total program. Televised instruction could then assume its rightful position as a useful tool with unique potentialities for the enhancement of certain types of instructional materials.

[3] The TV and control groups were equated with respect to class, sex, intelligence, and achievement in psychology, English, and mathematics. See references 5 and 6.

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"We Have Given Our Lives"

"What difference does it make if we ourselves do not reach the uplands? We have given our lives to the enterprise, and that is richer, and the moral greater."

Woodrow Wilson

TV and the Teaching of English

A thoughtful observer presents half a dozen aspects of teaching that appear to be ignored by enthusiasts for TV teaching and urges his fellow English teachers to be alert in seeking the answers to teaching problems complicated by mounting enrollments. The author (A.B., California; M.A., Ph.D., Northwestern) has taught in a California high school and at Northwestern, became head of English at Creighton University, and in 1954 became head of English at new Lamar State College, founded in 1951 in Beaumont, Texas.

By ROBERT NOSSEN

ABOUT 3 MILLION *are currently enrolled in college;* 4½ million are projected by 1965. If this figure is seen in terms of freshmen taking required courses in composition, and sophomores taking required courses in literature, the numbers, from the point of view of this discipline, become even more impressive. As has been obviously true in the past, the current social development is paralleled by a corresponding development in technology. Consequently, the phenomenon of our greatly increased population and school-population is accompanied by our ability to reach mass audiences both audially and visually. It was early conceived that the medium of television was the answer to all teaching problems. Proponents of the medium found a ready and eager audience among foundations which have given and are giving vast sums for such educational experimentation; administrators and legislators have eagerly grasped at the notion as a way to alleviate the teacher shortage, to spread instruction to a vast audience, and to cut costs: this, despite the enormous cost of initial installation and of maintenance.

This early conception involved the teaching of English, the subject first and still most frequently offered via TV. This has been with good reason: freshman English has always been the favorite of budget cutters; the results have ranged from those "altruistically" exempting "promising" students from its rigors, to those hiring masses of young graduate students at bargain prices, such instructors being outnumbered only by the masses they have taught. To meet the problem by TV, then, seemed a most promising solution to the simple matter of students being able to express themselves effectively, logically, and clearly, and being able to read with fair comprehension and some semblance of speed and accuracy.

The literature available on the subject of TV instruction, especially in the field of English, is simply overwhelming, encompassing not only articles found in the usual journals and popular magazines, but also pamphlets and studies privately printed and privately circulated. I do not purport to have exhausted this reading matter: it would be too much like trying to keep up with the interpretations of HAMLET, and about as rewarding. From what I have read, I have reached two basic conclusions: first, as already indicated, that the literature is voluminous; and secondly, that what has been written can quite easily be boiled down to a remarkably few basic points.

This paper, therefore, examines the available conclusions, notes weaknesses, and suggests problems needing further analysis before English teachers may willingly accept this teaching medium. This paper will seek neither to defend the medium nor to damn it; it is too late for either. But what do we know to this point? And what more do we need to know before we can intelligently proceed from here?

The most telling point the defenders of TV instruction in English have tried to make is that students instructed by TV (and this conclusion has been offered alike for closed-circuit instruction and for open-channel educational stations) equal or even surpass those students subjected to traditional classroom instruction, insofar as achievements on tests determine. Unfortunately, this may very well be true, and I do not doubt that it is, but it still leaves most of the important questions unanswered. There are many ways to instruct students and to arrive at objectively measured and seemingly desirable results, and TV represents only one small phase of such methods. But what happens to the students so instructed when measured against certain other basic considerations; or even more important, when measured against their place in the total learning

community? The following, certainly, must be considered important:

▸ *The lack of stimulation or even freedom for the teacher to deviate from formal subject matter.*

Much of what a student should receive in the classroom is never measured in tests; and I for one deplore the teacher or the type of teaching that is solely aimed at having the students score well on a preconceived examination. In literature, there is necessarily much that must be spontaneous, built upon the relationship of a particular literary work to an artistic performance on the campus, in the community, or even on TV. Any good teacher has had the experience of finding a class hour develop far from his original intentions, and he has come forth from that classroom, as have his students, with new ideas, a new curiosity, and a new zeal for his discipline. A meticulously prepared lecture can never furnish this. In fact, among my own experiences, those professors who most carefully lectured from carefully prepared materials were the most unimaginative and the most dull. And yet TV instruction depends entirely upon lessons prepared down to the last detail, aiming, of course, at the student's acquisition of a particular skill, even if that skill be nothing more than the placing of commas to set off parenthetical expressions.

▸ *The performer requirements of the lecturer, rather than the requirements for scholarly achievement.*

A college or university is still a community of learning, whereby the faculty continues to investigate and to share its investigations with students. Otherwise, there is little to distinguish its learning processes and facilities from those of a high school. True, some instructors may be far more interested in pursuing learning than in sharing it, but even this is part of the total of a student's learning experience. Under the demands from TV instruction, I have heard it stressed, the emphasis is placed upon the "good teacher." Perhaps, but it seems much more likely that the emphasis is placed upon the good actor. Actually, a fine personality may assume the role of professor and mouth wisdom perhaps even beyond his own understanding. After all, it's just canned material, and not many of us can compete with Charles Laughton or Lawrence Olivier in presenting materials orally. Real teaching, of course, goes beyond fine presentation: I have received some of my finest learning experiences from men who could hardly compete for an Emmy.

▸ *Lack of library facilities and demands.*

In far too many concepts of TV teaching, the lecture and the text have comprised the total of the learning experience. In its outlandishly extensive open-channel educational programs for credit, the city of Chicago prides itself on the number of hours weekly spent on each course before the TV screen. This is the height of ridiculousness. The instructor at best can only be a guide: the student must learn from books; and the central place for books is in the library. In this same Chicago situation, and I know the same is true in Houston and elsewhere, it is pointed to with pride that a student need appear on campus only for final examinations. I have never seen it even mentioned that a particular course will demand the discipline of library searching: to collect materials, to analyze them, to collate them, and to conclude from them. This could, of course, be less true in closed-circuit classes; nevertheless, even in such instruction I have never seen the library indicated as a major phase of the learning process.

▸ *Direct connection of learning with discipline.*

No demands have been made for discipline, either in the art of listening, or in the necessity for responding to TV instruction. Rather, the lack of discipline has been one of the key complaints made by those who have taught by TV, that is, closed-circuit TV. In open-channel instruction, the instructor neither knows nor cares about the reaction of his audience, their listening habits, their note-taking, their alertness, their intellectual curiosity. They need only pass an examination which, in many cases, they can do anyway with a little help from a syllabus which is most carefully prepared and distributed in advance, containing close to the sum total of knowledge that the instructor is going to impart.

▸ *Participation in cultural programs on the campus*

A college is not merely a collection of students and teachers, but again, a community of learners. Growth is accomplished not only in the classroom, but in the "bull sessions," in the lectures delivered by prominent speakers from

outside, in dramatic and musical events. And the TV classroom, especially open-channel, makes no provision for this, and cares less. And yet the classroom is only incidental to the growth necessary to make an educated, that is, an integrated, sensitive, appreciative man or woman.

► *Finally, the failure of objective testing.*

All the objective testing in the world will not evaluate a student's basic ability to read effectively, and to write clearly and accurately, to organize, to develop and to support his points. And yet, the achievement so proudly noted by the TV enthusiasts is primarily based upon objective examining, and not upon the constant and continuing process of reading and writing which is the heart and soul of any course in English.

In summary, then, these six points have found their way into no study of educational TV that I have come across. They demonstrate, I believe, the basic weaknesses of the medium for instruction. They tend to invalidate the claim that students do as well as those in the traditional classroom, and they point up how many areas need further study.

But what of those who have made use of the medium to date for instruction: what have been their reactions? It might be well here to survey the most pertinent remarks of those teachers across the country who have participated in such programs. Such comments range, as might be expected, from loud praises from those who have instigated the programs, to loud lamentations and, at best, doubts from those who have actually done the teaching.

Actively engaged in open-channel educational TV has been the University of Houston, which has among the most elaborate setups for such teaching, and one of the broadest programs. Two of the members of the English Department at the University of Houston were most gracious in commenting about their own experiences. One wrote, "Though the experiment was interesting, I am quite sure we did not solve the Freshman English dilemma. The mechanical limitations of the television and the remoteness of the student in respect to where he was during a class period seemed to be most unsatisfactory . . . It seems to me, further, that to teach effective writing on television is at this time impossible at least so far as our facilities are concerned. English is a subjective proposition. All who participate must be in touch with each other at all times." The other wrote, "My biggest problem thus far has been the TV administrators. They ape their fellows in every branch and in addition have the aura of 'Show-biz' about them. I find them garrulous and indecisive, but I presume that such an experience is inevitable. I cannot secure much help from them towards visual aids. Many of the dramatic things I would like to use have TV rights tightly sewed up."

Specific problems, of course, have from time to time made their appearance. The Chicago Teachers Union has been concerned over kinescope recordings of TV lectures, the Union has received a contract whereby such recordings may be retained but two weeks, and then must be destroyed. And a meeting of the American Psychological Association last fall spent its sessions on the problem: the result was stress again only upon methods and techniques.

Nevertheless, enrollments will continue to rise, and the medium of TV is with us. They will continue to combine. English teachers must face the reality; they must experiment, must search for answers. Otherwise, inevitably, ready-made answers will be found for them.

Retrocession

"More particularly are the years after a great war apt to be years of apparent retrocession; men are too weary to see what has been done, what has been cleared away, and what has been made possible."

H. G. Wells
The Outline of History
New York: The Macmillan Company.
1921. Page 1091.

"Swinger of Birches"

A SWINGER OF BIRCHES: A PORTRAIT OF ROBERT FROST by Sidney Cox. New York: New York University Press. 1957. xi + 177 pp. $3.75.

PERHAPS "A Swinger of Birches" might seem an apt title for a book about a man who had taught school for years in New England. The guess misses the mark. Not quite totally, for the book has very profound implications for education and the process of learning at all levels. Robert Frost has been a teacher in schools and colleges, and through his poetry, a teacher in a wider sense, all his life. He has been and continues to be a great teacher, a phenomenon all too rare in any age.

I recommend highly *A Swinger of Birches* to my fellow teachers everywhere and especially to my colleagues who teach in college, for we perhaps more than others need the fresh stimulation of this book.

A Swinger of Birches is not a biography in the usual sense. The reader will find almost nothing here of the facts about Robert Frost's life and development. Doubtless, that kind of material can be found elsewhere. This book is a delightful presentation of some of the major strands of Frost's thought made interesting and clear by abundant use of direct quotations from conversation, lectures and poetry, and indirect quotations of thought which are enriched by Mr. Cox's own insights.

Each of the thirty-seven very brief chapters develops with Frost-like economy of words a special aspect of the poet's thought. The writing is based upon somewhat more than forty years of intimate intellectual (and I take it, personal) relation between Robert Frost and Mr. Cox. The result for the thoughtful reader is a similar intimacy with the ideals and attitudes of "the wisest man I know" as the author says in his brief preface.

And what does the title mean? Why is the thought of the volume so important for teachers? In planning this little review I had determined to try to answer both of these questions but later thought better of it. The reader should not be robbed of finding both answers for himself.

The book is full of excellent quotations: sentences which carry significant immediate meaning and stir long delayed thought. Here are a few samples taken at random and thus out of context:

> The feelings that give us power and lead to wisdom are the feelings we can't help learning. p. 9.
>
> Robert saw through him all right. And he didn't see anything that wasn't there; he was too genuine and clear-seeing to be fooled. But his seeing what was there made it swell like a sun-stirred seed. p. 14.
>
> We had to have unarguable, undemonstrable, unmistakable axioms, just three or four. And if we didn't abuse our minds, we should surely have them. One such is genuineness is better than pretense. Another is that meanness is intolerable in oneself. And another is that death is better than being untrustworthy. p. 50.
>
> He has wanted to win the affection of many of his fellows, and holding fast to all that really matters, with no crowding and no infringement, to show them how to have ideas. p. 48.
>
> Something should save the students from supposing that the way of intelligence is eliminating opposition and waste. Something must be present in education to remind them that as lying down goes with love, so waste goes with growth and opposition with night and day. p. 51.

E. V. PULLIAS, Professor of Higher Education, University of Southern California.

Other Recent Books

BETTER HANDWRITING by Paul V. West. New York: Barnes & Noble, Inc. 1958. viii + 102 pp. $1.00.
"How to analyze and improve your penmanship"—basic considerations, diagnosis of faults, remedial measures, figures, plates, index.

BUILDING A SUCCESSFUL COLLEGE CAREER by Homer L. J. Carter and Dorothy J. McGinnis. Dubuque, Iowa: Wm. C. Brown Company. 1958. x + 161 pp. $2.50.
"Preventive measures must be undertaken if we are to conserve student potential." Seventeen chapters for orientation and guidance of the student, directed to student himself. Book embodies twenty-five years of application by thousands of college students.

THE ELEMENTARY SCHOOL CHILD. A Book of Cases, by Cecil V. Millard and John W. M. Rothney. New York: The Dryden Press. 1957. xii + 660 pp. $4.90.
The teacher inescapably is concerned with individual pupils. Case histories of 22 boys and girls are presented in fascinating detail in each instance, "sandwiched in between a Preview of him as he appeared on entering school and a Postcript describing him on his exit from high school." The conclusion calls attention to some findings and general conclusions which have received little emphasis in the literature. Listed in winter issue with incomplete title.

EVALUATION TECHNIQUES FOR CLASSROOM TEACHERS by Denis Baron and Harold W. Bernard. New York: McGraw-Hill Book Company, Inc. 1958. xi + 297 pp. $5.50.
"Educational and psychological tests do not make analyses or suggest what should be done but they sharpen and clarify teachers' judgments." Lucid treatment with many suggested references.

CHILTON'S AUTOMOTIVE JOB SHEETS by Harold S. Bostwick and Randolph R. Burr. Philadelphia: Hilton Company. 1958.
Volume I. The Engine with Supplement on the Fuel System. xiii + 132 unnumbered pp. $3.80.
Volume II. The Chassis. xii + 74 unnumbered pp. $2.45. Volume III, The Automotive Electrical System. xii + 72 unnumbered pp. Teachers' Manual and Sourcebook. x + 85 pp. $1.35.
Units in Volumes I-III are numbered. Excellent printing of text and illustrations. Intended for secondary schools, high and vocational.

CRISIS IN HIGHER EDUCATION by Charles P. Hogarth. Introduction by Ernest V. Hollis. Washington, D.C.: Public Affairs Press. 1957. vi + 60 pp. $1.00.
"At last there is a short book in plain English that gives a concise overview of the operation of American institutions of higher education."

GROUP WORK IN EDUCATION by Ruth Strang. New York: Harper & Brothers. 1958. x + 322 pp. $5.50
Excellent, comprehensive presentation of the philosophy, educational uses, values and limitations of group dynamics and group work.

A HANDBOOK FOR THE AMATEUR THEATRE by Peter Cotes. New York: Philosophical Library, Inc. 1957. xxiii + 423 pp. $12.50.
Twenty-two chapters, glossary, bibliography, four appendices, index, and illustrations make up a volume remarkably comprehensive and practical on amateur theatre in general and British Commonwealth in particular. "Much of the inside information will give new pleasure to theatre-going."

HOME ECONOMICS CAREERS AND HOMEMAKING by Olive A. Hall. New York: John Wiley & Sons, Inc. 1958. xv + 301 pp. $4.25.
Author is assistant professor of home economics at University of California, Los Angeles. Interprets home economics as preparation for personal and home life as well as for a career. Planned for use in a general introductory course for college home economics students. Good illustrations.

HOW TO IMPROVE YOUR MEMORY by James D. Weinland. New York: Barnes & Noble, Inc. 1957. vi + 149 pp. $1.00.
"Memory is the reward of meaningful experience." Author has had lifelong interest in memory training, long experience, and has taught psychology in college for many years. Gives scientific facts and useful suggestions.

HOW TO TAKE EXAMINATIONS IN COLLEGE by J. N. Hook. New York: Barnes & Noble. 1958. viii + 180 pp. $1.25.
"A guidebook with sample questions, answers, and a supplement on College Entrance Examinations." Intended for students, but many a teacher may find suggestions here for examinations and for ways of helping students prepare for and pass examinations.

NEW FRONTIERS OF KNOWLEDGE: Symposium by Distinguished Writers, Notable Scholars, and Public Figures. Washington, D.C.: Public Affairs Press. 1957. x + 125 pp. $2.75.
Based on broadcasts throughout the world by United States Information Agency. Beginning with Charles Malik on "The Future of Freedom" and ending with Whitney Griswold on "Overview" thirty-six men and women are heard briefly but memorably on issues vital in our time.

MORAL VALUES IN PUBLIC EDUCATION by Ellis Ford Hartford. New York: Harper & Brothers. 1958. xi + 338 pp. $4.00.
"This book affirms the point of view of the Kentucky Movement that the teaching of moral values is appropriate and timely for the public schools in a diverse, democratic society." "Goes beyond hypothesis and debate of issues to solid evidence of what can be done."

A STRATEGY FOR AMERICAN EDUCATION by Robert Hendry Mathewson. New York: Harper & Brothers. 1957. xi + 296 pp. $5.00.
Designed for school administrators, students of education and school administration, school board members, and the active citizen. Three alternative routes for education: the academic-intellectual, the socioeconomic-utilitarian, the personal-social-developmental. "We shall need a revitalized system of education, if not the sort described in this book, then something roughly resembling it."

WHAT'S HAPPENED TO OUR HIGH SCHOOLS? by John F. Latimer. Washington, D.C.: Public Affairs Press. 1958. vi + 196 pp. $3.25.
Author is professor of classics and assistant dean of faculties at George Washington University. "The answers may or may not be pleasing; in many cases they are most certainly not final." The essential ingredients must be science *and* the humanities, *not* science *or* the humanities."

WORKING WITH STUDENT TEACHERS by Stratemeyer and Lindsey. New York: Bureau of Publications, Teachers College, Columbia University. 1958. x + 502 pp. $4.75.
Written in two parts. Part I is written for the supervising teachers on the role of the student teacher concerning their responsibilities to the college—school—and community. Part II deals with factors to consider when making student teaching assignments, planning and guiding learning activities, evaluating growth of learners and student teacher importance and with kinds of conferences and ways to guide your student from the college student to a member of the profession.

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